Integrated Water Flow Model

IWFM v3.02

revisions 36, 65 and 91

User's Manual

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Modeling Support Branch
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1. Introduction

The purpose of the IWFM user's manual is to serve as a guide for populating input files, running IWFM and understanding the model results. This chapter briefly describes IWFM and the development of the model. A summary of this manual is included in this chapter to help guide the user when working with IWFM.

1.1. IWFM Description

IWFM is a Fortran code written using a mixture of Fortran 95 and Fortran 2003 languages. The model is comprised of a pre-processor, simulation component and post-processors (Figure 1.1). IWFM must be run sequentially and the output generated from one program must be transferred to the next before beginning a model run.

1.2. Summary of IWFM User's Manual

Chapter 1	Introduction
Chapter 2	Discusses general topics related to time-tracking simulation option, preparation of time series input data and file formats recognized by IWFM
Chapter 3	Descriptions of the pre-processor subroutines, input files and output files presented in this chapter
Chapter 4	Details of the subroutines included in the simulation program as well as input data files and output files

	generated
Chapter 5	Descriptions of the budget tables and the required input needed to tabulate simulation results
Chapter 6	Step-by-step guide of how to run IWFM, which includes running the pre-processor, simulation and budget portions of the program

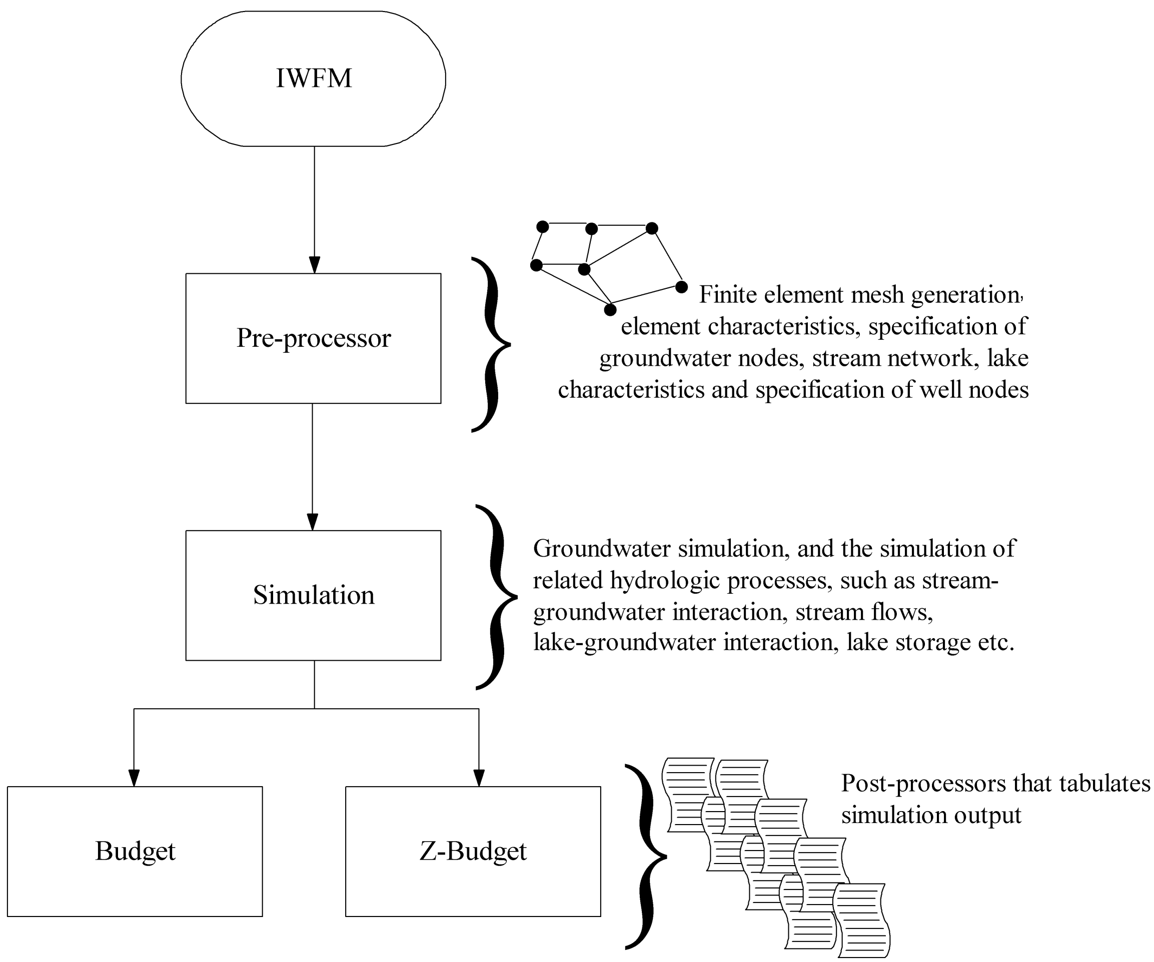


Figure 1.1 IWFM program structure

2. General Topics

2.1. Simulation Time Tracking

IWFM offers two simulation options, namely *time tracking* and *non-time tracking* simulations. In a time tracking simulation, IWFM is aware of the actual dates and times of the start and end of the simulation period. In a non-time tracking simulation, the start of the simulation period is always tagged as time zero and the simulation time is referenced simply by the number of time steps elapsed.

i. Time Tracking Simulation

During a time tracking simulation IWFM keeps track of the date and time of each time step. In such simulations, each data entry in input time series data files is required to have a date and time stamp which allows IWFM to retrieve time series data correctly. This, in return, allows the user to maintain a single set of time series input data files for applications where the starting and ending date and time of the simulation may change. For example, during the calibration stage of a project, the simulation is run for two periods: calibration period and the verification period. In a time tracking simulation, time series input data files can be prepared so that the data covers both the calibration and verification periods. Then the same time series data files can be used for both calibration and verification runs without the need for modification. Since a time tracking simulation keeps track of actual date and time of each of the simulation time steps, IWFM can retrieve the correct data from the time series data files.

Time tracking simulations allow usage of HEC-DSS files as well as ASCII text files for time series data input and output. HEC-DSS is a database format designed by Hydrologic Engineering Center (HEC) of U.S. Army Corps of Engineers specifically for time-series data encountered in hydrologic applications. These files allow efficient storage and retrieval of hydrologic time series data, and HEC offers free utilities (HEC-DSSVue and DSS Excel add-in) for manipulation, visualization and analysis of data stored in DSS files. These utilities and instructions on how to use DSS files can be downloaded from HEC web site at www.hec.usace.army.mil.

Another advantage of time tracking simulations is that results that are printed to output files have date and time stamps associated with them. This allows easy comparison of simulation results to observed values which generally come with the date and time of observation.

It is anticipated that most IWFM applications will use the time tracking simulation option.

ii. Non-time Tracking Simulation

In this simulation option, IWFM is not aware of the actual date and time for the start and end of the simulation period. The start of the simulation period is always zero, and the time during the simulation period is referred to by the elapsed time steps. For instance, assuming length of simulation time step is a month, elapsed simulation time will be referred as month 1, month 2, month 3, etc.

Since IWFM has no means to keep track of actual date and time in a non-time tracking simulation, it is up to the user to arrange the time series input data for proper data reading. For instance, in the calibration stage of a project where the simulation is run for a calibration period and for a verification period, the user will have to maintain two sets of time series input data files. One of these sets will be for the calibration period where the first data corresponds to the first time step in the calibration period, and the other set will be for the verification period where the first data corresponds to the first time step in the verification period.

In non-time tracking simulations, the results will be printed to the output files for each time step without a specific date and time. It is up to the user to convert absolute time steps to actual dates and times to compare them to observed values which generally come with the actual date and time of the observation. Furthermore, in such simulations only the usage of ASCII text files are allowed and the DSS files cannot be used for input or output of time series data.

It is anticipated that non-time tracking simulation option will be used mainly for theoretical problems such as the validation of numerical methods used in IWFM.

2.1.1. Length of Simulation Time Step

i. Time Tracking Simulation

In order to be consistent with the standards of HEC-DSS database files, IWFM restricts the length of simulation time step that can be used in an application. The allowable time step lengths are listed in Table 2.1.

ii. Non-time Tracking Simulation

The length of the simulation time step can be any number that is greater than zero. The user specifies a "tag" for the length of time step but IWFM does not recognize this tag. For example, the length of the time step can be 0.25 and the tag can be “month” IWFM uses the value 0.25 when the numerical methods require a value for Δt (see IWFM Theoretical Documentation), but the “month” tag does not represent anything for IWFM;

Time Step Length	**IWFM Notation**
1 minute	1MIN
2 minutes	2MIN
3 minutes	3MIN
4 minutes	4MIN
5 minutes	5MIN
10 minutes	10MIN
15 minutes	15MIN
20 minutes	20MIN
30 minutes	30MIN
1 hour	1HOUR
2 hours	2HOUR
3 hours	3HOUR
4 hours	4HOUR
6 hours	6HOUR
8 hours	8HOUR
12 hours	12HOUR
1 day	1DAY
1 week	1WEEK
1 month	1MON
1 year	1YEAR

Table 2.1 List of allowable time step lengths in time tracking simulations

it does not know that 0.25 month represents 7.75 days in March, and 7.5 days in April.

2.1.2. Time Stamp Format

In time tracking simulations, start and end date and time of simulation period as well as the date and time of each data entry in time series data input files are required to be specified by using a time stamp. The format of the time stamp is as follows:

MM/DD/YYYY_hh:mm

where

MM	=	two digit month index;
DD	=	two digit day index;
YYYY	=	four digit year;
hh	=	two digit hour in terms of military time (e.g. 1:00pm is represented as 13:00);
mm	=	two digit minute.

The time is represented in military time and midnight is referred to as 24:00. For instance, 05/28/1973_24:00 represents the midnight on the night of May 28, 1973. Another example is the starting date and time of a simulation period: if the initial conditions for a monthly simulation is given for the end of September 30, 1975, then the time stamp for the starting date and time of the simulation will be 09/30/1975_24:00. The first simulation result will be printed for October 31, 1975 at midnight with the time stamp 10/31/1975_24:00.

2.1.3. Preparation of Time Series Data Input Files

i. Time Tracking Simulation

In time tracking simulations, the user is allowed to use a mixture of ASCII text and DSS files for time series input data. In preparing these files, the user should follow the rules listed below:

1. The data should have a regular interval. Gaps in the data are not allowed. For instance, if the data is monthly a value for every month should be entered.
2. The time stamp of the data represents the end of the interval for which the data is valid. For instance, in monthly time series stream inflow data, a data point time stamped with 08/31/1995_24:00 represents the inflow that occurred in August of 1995. As another example, if the starting date and time of the simulation period is 12/31/1970_24:00 (i.e. initial conditions are given at the midnight of December 31, 1970) in a monthly simulation, then IWFM will search for the time series data time stamped as 01/31/1971_24:00 (data for the month of January in 1971) in the time series input files.
3. The smallest interval that can be used for time series data is 1 minute.
4. A time series input data can be constant throughout the simulation period. If an ASCII text file is used for data input, the time stamp for the constant value can be set to a date and time that is greater than the ending date and time of the simulation period. For instance, if the simulation period ends at 06/15/2003_18:00 (6:00pm on June 15, 2003), then the constant value can

have a time stamp 12/31/2100_24:00 (midnight on the night of December 31, 2100). IWFM reads the constant value for the midnight of December 31, 2100 and uses this value for all simulation times before this date and time. Generally, time series input files include conversion factors to convert only the "spatial" component of the input data unit. The temporal unit is deduced from the time interval of the input data. In the case of constant time series data, IWFM is not able to obtain the time interval and, hence, the temporal unit. If a constant value for time series data is used, the user should make sure that appropriate conversion factors are supplied so that the temporal and spatial units of the input data are consistent with those used internally in Simulation. Time series data that is constant can also be represented in DSS files but this is not suggested.

5. For rate-type time series data (e.g. stream inflow data), the time unit is assumed to be the interval of data. For instance, if the stream inflow data is entered monthly, IWFM assumes that the time unit of the flow rates is 1 month. When time series data is a constant value for the entire simulation period IWFM has no way to figure out the time unit of the input data. In this case the user should make sure that the time unit of data is the same as the consistent time unit of simulation

6. For recycled time series data (e.g. fraction of total urban water that is used indoors given for each month but do not change from one year to the other), the year of the time stamp can be set to 4000. Year 4000 is a special flag for IWFM such that it replaces year 4000 with the simulation year to retrieve

the appropriate data from the input file. As an example consider the time series data in Table 2.2 for the fraction of total urban water that is used indoors. This data set represents that for the first third of each simulation year the urban water indoors usage fraction is 0.7, for the second third it is 0.5 and for the last third it is 0.35. Recycled time series data can be used in both ASCII text and DSS files. If a monthly time series data is to be recycled the user should enter the time stamp for the last day of February as 02/29/4000_24:00 to address both the leap and non-leap years.

7. The interval of time series data is required to be synchronized with the simulation time step. Table 2.3 shows examples of accepted and unaccepted situations. It should be noted that IWFM will continue to read data from the input files even if the data interval is not properly synchronized with the simulation time step. However, in such cases there is no guarantee that the correct data will be retrieved from the input file. Therefore, it is up to the user to ensure correct synchronization between the input data and the simulation time step.

Time Stamp	Fraction of Urban Indoors Water
04/30/4000_24:00	0.70
08/31/4000_24:00	0.50
12/31/4000_24:00	0.35

Table 2.2 Example for representation of recycled time series data

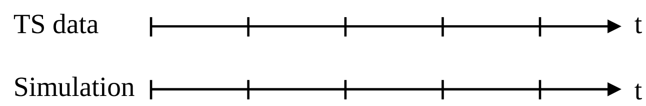
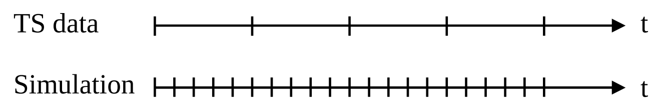
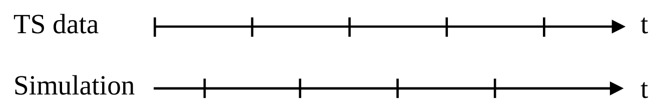
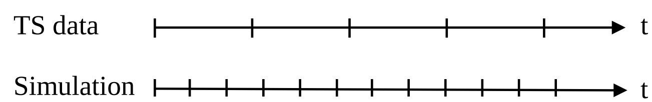
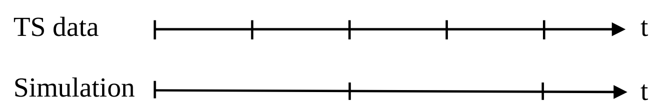
Situation	Graphical Representation	Accepted
Monthly time series data, monthly simulation		Yes
Monthly time series data, daily simulation		Yes
Monthly time series data, monthly simulation (TS data times don't match simulation times)		No
Monthly time series data, weekly simulation		No
Monthly time series data, yearly simulation		No

Table 2.3 Examples for acceptable and unacceptable cases for the syncronization of time series data interval and the simulation time step

ii. Non-time Tracking Simulation

In this case, the first data entry in the input data file should always correspond to the first time step in the simulation. Recycled time series data as well as data that is constant throughout the simulation period can be represented using NSP_ and NFQ_ variables (see the chapter on Simulation for more details). The time tag for each entry in the data file should be an integer number. This number is simply for the user to track the time series data; IWFM does not use it for any purposes.

2.2. Input and Output Data File Types

IWFM can access multiple file formats: (i) ASCII text, (ii) Fortran binary, and (iii) HEC-DSS files. The user can use several file formats in a single application. For instance, some of the input time series data can be read from HEC-DSS files whereas the rest can be read from ASCII text files. Some of the time series simulation results can be printed out to ASCII text files and the others can be printed out to HEC-DSS files.

Although IWFM allows usage of several file formats in a single application, some of the input and output files are required to be in specific formats. For instance, all budget output files generated by Simulation and read in by Budget or Z-Budget post-processors are required to be in Fortran binary format. Another example is the main control input files for all IWFM components; these files are all required to be in ASCII text file format.

IWFM recognizes the file formats from the file name extensions. Table 2.4 lists the file name extensions that are recognized by IWFM for each of the file formats.

File Type	Recognized File Name Extensions
ASCII	.DAT
	.TXT
	.OUT
	.IN
	.IN1
	.IN2
	.BUD
Fortran binary	.BIN
HEC-DSS	.DSS

Table 2.4 File name extensions recognized by IWFM

3. Pre-Processor

The pre-processor is the first portion of IWFM that is executed when running the model. The program compiles time-independent data such as the spatial, hydrologic, and stratigraphic characteristics specific to a simulation project. Specification of the finite element mesh, element soil characteristics, stratigraphy, stream network, lakes and wells within the model domain are processed in this part of IWFM. This chapter gives a description of the pre-processor subroutines, input and output file descriptions and sample input and output files.

3.1. Subroutine Descriptions

The pre-processor is a procedural FORTRAN program, and consists of a main program and subroutines (Figure 3.1). This section describes each subroutine included in the pre-processor program.

Iwfm_f1 The main program, which reads the main pre-processor input file (Unit 5). Iwfm_f1.for generates a binary and ASCII output file. The binary file contains information necessary to run the model simulation. The ASCII output displays processed data read by the pre-processor.

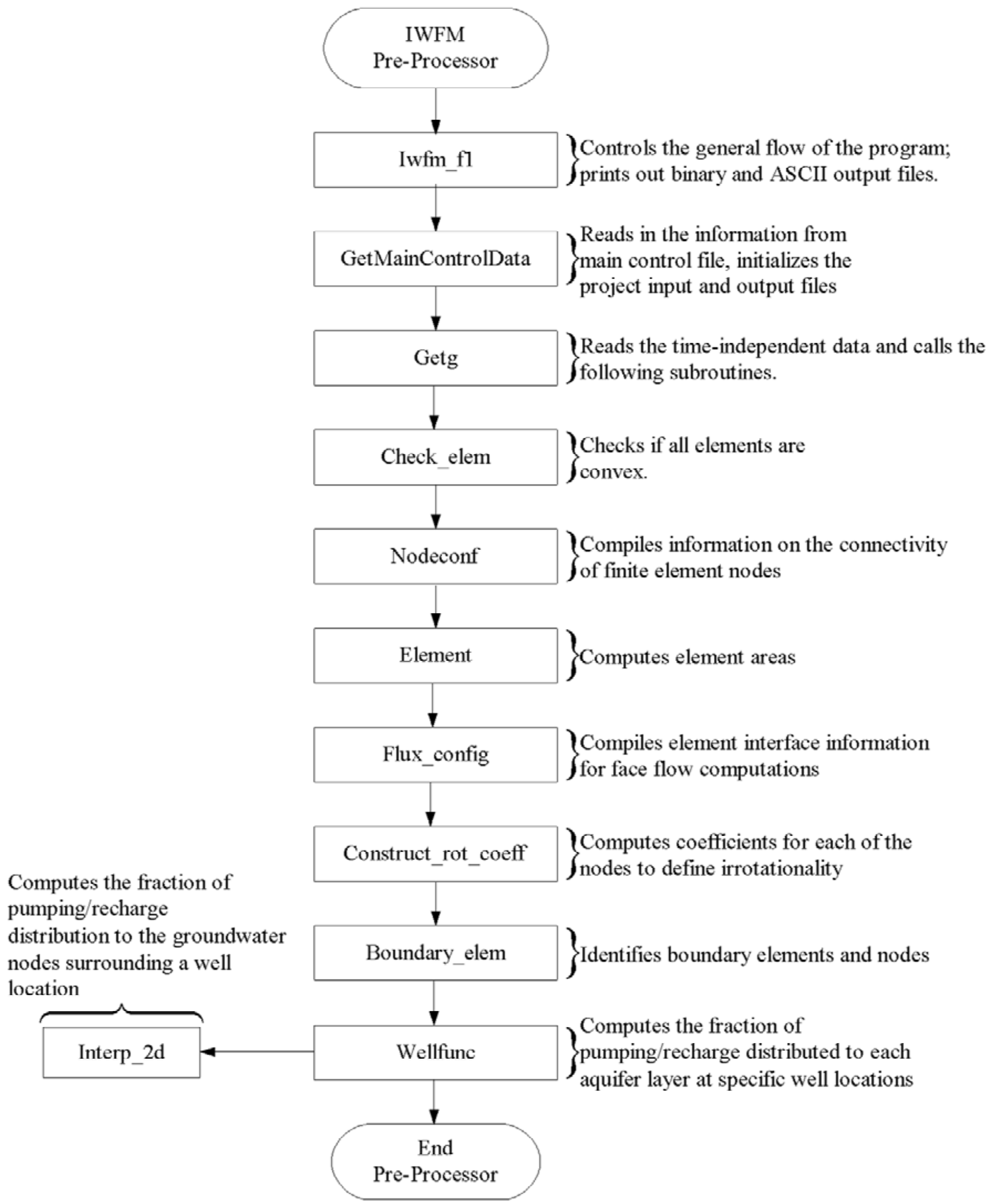


Figure 3.1 IWFM pre-processor subroutines

GetMainControlData This subroutine opens and reads in the title of project, file names, output options and output conversion factors from the main input file. It also opens and initializes the project input and output files.

Getg This subroutine reads and processes the time-independent input data. The time independent data read in Getg is as follows: Nodal x and y coordinates, stratigraphy of groundwater layers, stream network, lake characteristics, well locations and characteristics, and element characteristics. Getg also establishes the JND and NJD arrays that are used to store the non-zero components of coefficient matrix and row-column locations.

Check_elem This subroutine checks that all finite elements are convex, i.e. the internal angles at each node of an element are larger than 180 degrees.

Nodeconf This subroutine compiles information based on the finite element nodes specified in the nodal coordinate data file (Unit 8) to be used for compact storage of matrices and vectors used in the solution of the quasi three-dimensional groundwater equation.

Element This subroutine calculates elemental areas based on the nodal coordinates specified in Unit 8.

Flux_config This subroutine numbers each of the element interfaces and identifies the interface numbers that meet at each finite element node. This information is used in Simulation in computing the flow rates through element interfaces.

Construct_rot_coeff This subroutine computes the relevant coefficients to define the irrotationality of the flow field at a closed path around each finite element node.

Boundary_elem This subroutine identifies the element numbers and corresponding element faces that lie on the entire modal and the subregional boundaries.

Wellfunc This subroutine determines the fractions to vertically distribute the pumping/recharge to each aquifer layer.

Interp_2d This is the interpolation routine that computes the relative proportion of pumping distributed to the groundwater nodes surrounding the well location.

3.2. Input Files

This section consists of input file explanations, the description of variables in each pre-processing input file and sample input files. The user should not judge input file spacing based on the sample input files provided in this documentation, instead refer to the input files from a copy of IWFM.

Table 3.1 specifies the input files that contain required and optional data to run the pre-processing portion of IWFM. The status is based on the input files required to simulate groundwater flow with IWFM, versus groundwater flow simulation in conjunction with other model features, such as stream flows, and lakes.

Pre-Processor Main Input File   Unit 5

The main input file allows a maximum of three lines for a title that is printed to the ASCII output file (Unit 6). 'C', 'c', or '*' should not be in the first column of any of

File	Description	Status
Unit 7	Element and node specification	Required
Unit 8	Spatial location of all nodes	Required
Unit 9	Composition of groundwater layers	Required
Unit 10	Stream configuration	Optional
Unit 11	Lake configuration	Optional
Unit 12	Well locations and characteristics	Optional
Unit 13	Hydrologic characteristics of each element	Required

Table 3.1 List of IWFM pre-processor input files

the title lines. All pre-processor input file names are read from the main input file and associated with a unit number within the program. All input and output file names must be no more than 50 characters long, and each file name must be within the first 50 columns. Simply leave any file name specification columns blank if an input file is not used. Groundwater simulation requires element configuration data (Unit 7), nodal coordinate data (Unit 8), stratigraphy (Unit 9), and element characteristics (Unit 13). The pre-processor can output all units of length and area, given that the user specifies the conversion factor from simulation units to output units of length and area. The following list represents each input variable specified in Unit 5:

KOUT	Option to print time-independent data read by the pre-processor program
KDEB	This print option allows the user to print program messages on the screen during execution of the pre-processor or print the non-zero finite element stiffness matrix components
FACTLTOU	Factor to convert simulation unit of length to the user specified output unit of length
UNITLTOU	The output unit of length, described in a maximum of 10 characters
FACTAROU	Factor to convert simulation unit of area to the user specified output unit of area
UNITAROU	The output unit of area, described in a maximum of 10 characters

```
C*******************************************************************************
C
C                   INTEGRATED WATER FLOW MODEL (IWFM)
C                        *** Version ### ***
C
C*******************************************************************************
C
C                             MAIN INPUT FILE
C                         for IWFM Pre-Processing
C                                (Unit 5)
C
C
C              Project:
C              Filename:
C
C*****************************************************************************
C                      Titles Printed in the Output
C
C    *A Maximum of 3 title lines can be printed.
C    *Do not use '*' , 'c' or 'C' in the first column.
C
C                           **********************
                                   IWFM
                            Version ### Release
                                    DWR
C                           **********************
C*****************************************************************************
C                             File Description
C
C   *Listed below are all input and output file names used when running the
C    pre-processor for IWFM simulation.
C
C   *Each file name has a maximum length of 200 characters
C
C   *If a file does not exist for a project, leave the filename blank
C    For example, if lakes are not modeled in the project, the file name and
C    description columns for unit 11 will appear as:
C
C    FILE NAME                                     UNIT DESCRIPTION
C                                                  /11: LAKE DATA
C-----------------------------------------------------------------------------
C    FILE NAME                                     UNIT DESCRIPTION
C-----------------------------------------------------------------------------
   OUTPUT1.BIN                                     / 4: BINARY OUTPUT FOR SIMULATION (OUTPUT, REQUIRED)
                                                   / 5: *** (Not used in this version) ***
                                                   / 6: *** (Not used in this version) ***
   ELEMENT.DAT                                     / 7: ELEMENT CONFIGURATION FILE (INPUT, REQUIRED)
   XY.DAT                                          / 8: NODE X-Y COORDINATE FILE (INPUT, REQUIRED))
   STRATA.DAT                                      / 9: STRATIGRAPHIC DATA FILE (INPUT, REQUIRED))
   STREAM.DAT                                      /10: STREAM GEOMETRIC DATA FILE (INPUT, OPTIONAL)
   LAKE.DAT                                        /11: LAKE DATA FILE (INPUT, OPTIONAL)
                                                   /12: WELL DATA FILE (INPUT, OPTIONAL)
   ELEMCHRC.DAT                                    /13: ELEMENT CHARACTERISTIC DATA FILE (INPUT, REQUIRED)
C------------------------------------------------------------------------------
C******************************************************************************
C                    Pre-Processor Output Specifications
C
C     KOUT; Enter 1 - Print geometric and stratigraphic information
C           Enter 0 - Otherwise
C
C     KDEB; Enter 2 - Print messages on the screen during program execution
C           Enter 1 - Print non-zero Finite Element Stiffness Matrix Components
C           Enter 0 - Otherwise
C-----------------------------------------------------------------------------
C  VALUE                          DESCRIPTION
C-----------------------------------------------------------------------------
     1                             /KOUT
     1                             /KDEB
C-----------------------------------------------------------------------------
C*****************************************************************************
C                   Unit Specifications of Pre-Processor Output
C
C     FACTLTOU; Factor to convert simulation unit of length to specified output unit of length
C     UNITLTOU; The output unit of length (maximum of 10 characters)
C     FACTAROU; Factor to convert simulation unit of area to specified output unit of area
C     UNITAROU; The output unit of area (maximum of 10 characters)
C
C-----------------------------------------------------------------------------
C    VALUE                        DESCRIPTION
C-----------------------------------------------------------------------------
    1.0                           /FACTLTOU
    FEET                          /UNITLTOU
    0.000022957                   /FACTAROU
    ACRES                         /UNITAROU
```

Element Configuration File Unit 7

Unit 7 details the element configuration for each element represented in the finite element mesh. Each element is configured from three or four nodal points. All elements that represent the model domain are either triangular or quadrilateral. A zero value for IDE(4) indicates that the element is triangular. Nodes corresponding to each element are specified in a counterclockwise manner. Element size should be based on observed or predicted groundwater head gradients throughout the model domain. Therefore, in areas where the flux is large, the size of the elements should be smaller than those located in areas of relatively small flow gradients. The following variables are required as input in Unit 7:

NE	Number of elements within the model domain
IE	Element number
IDE	Nodes corresponding to each element number; 3 nodes are associated with each triangular element (4^{th} node should be set to zero) and 4 nodes are associated with each quadrilateral element

```
C*******************************************************************************
C
C                    INTEGRATED WATER FLOW MODEL (IWFM)
C                           *** Version ### ***
C
C*******************************************************************************
C
C                        ELEMENT CONFIGURATION FILE
C                         for IWFM Pre-Processing
C                                 (Unit 7)
C
C
C             Project:  IWFM Version ### Release
C                       California Department of Water Resources
C             Filename: ELEMENT.DAT
C
C*******************************************************************************
C                            File Description
C
C   This file  contains the element configuration for each element.
C   The nodes that make a finite element are listed for each element in
C   a counter-clock wise fashion starting with any node. For triangular elements,
C   the fourth node is specified as zero.
C
C
C   For example,
C
C                    13--------------14-----------17
C                     I              I           I
C                     I      2       I   3   I
C                     I              I     I
C                     I              I   I
C                    15-------------- 16
C
C
C   The configuration for elements 2 and 3 will be listed as,
C
C            element   node 1    node 2    node 3   node 4
C               2        13        15        16       14
C               3        14        16        17        0
C
C*******************************************************************************
C                          Element Configuration Data
C
C    NE;    Number of elements within the model domain
C-------------------------------------------------------------------------------
C   VALUE                        DESCRIPTION
C-------------------------------------------------------------------------------
    400                          /NE
C-------------------------------------------------------------------------------
C*******************************************************************************
C
C   The data listed below represents all elements and corresponding nodes
C   within the model domain.
C
C   IE;       Element number
C   IDE;      Nodes corresponding to each element
C             *Note* IDE(4) is zero for all triangular elements
C
C-------------------------------------------------------------------------------
C   Element     ------------Corresponding Nodes------------------
C   IE          IDE(1)        IDE(2)        IDE(3)        IDE(4)
C-------------------------------------------------------------------------------
     1           1              2            23            22
     2           2              3            24            23
     3           3              4            25            24
     4           4              5            26            25
     5           5              6            27            26
     .           .              .             .             .
     .           .              .             .             .
     .           .              .             .             .
     397         416            417          438           437
     398         417            418          439           438
     399         418            419          440           439
     400         419            420          441           440
```

Nodal X-Y Coordinate File Unit 8

The nodal coordinate file contains each node number and corresponding x and y coordinates (in relation to a specific origin). Any coordinate units may be used as long as the appropriate conversion factor is given. This file sets up the spatial orientation of the groundwater nodes in the model domain. The finite element mesh is generated from the nodal coordinates, as well as relationship between elements and corresponding groundwater nodes (refer to Unit 7).

ND	Number of groundwater nodes
FACT	Factor to convert nodal coordinates to simulation unit of length
ID	Groundwater node identification number
X	x-coordinate of groundwater node location
Y	y-coordinate of groundwater node location

```
C*****************************************************************************
C
C                    INTEGRATED WATER FLOW MODEL (IWFM)
C                           *** Version ### ***
C
C*****************************************************************************
C
C                        NODAL X-Y COORDINATE FILE
C                         for IWFM Pre-Processing
C                                (Unit 8)
C
C
C             Project:  IWFM Version ### Release
C                       California Department of Water Resources
C             Filename: XY.DAT
C
C*****************************************************************************
C                            File Description
C
C   *This file includes all groundwater nodes that represent the model domain,
C    as well as the x and y coordinates that correspond with each node.
C
C   *The coordinates can be specified for any reference point and coordinate
C    system
C
C*****************************************************************************
C                    Groundwater Node Specifications
C
C   ND;    Number of groundwater nodes
C   FACT;  Conversion factor for nodal coordinates
C-----------------------------------------------------------------------------
C   VALUE                        DESCRIPTION
C-----------------------------------------------------------------------------
    441                          /ND
    1.0                          /FACT
C-----------------------------------------------------------------------------
C*****************************************************************************
C                      Groundwater Node Locations
C   The following lists the node number and x & y coordinate of each node
C
C   ID;   Groundwater node number
C   X,Y;  Coordinates of groundwater node location [L]
C
C-----------------------------------------------------------------------------
C   Node     ----------Coordinates----------
C    ID           X                 Y
C-----------------------------------------------------------------------------
      1        0.0               0.0
      2        2000.0            0.0
      3        4000.0            0.0
      4        6000.0            0.0
      5        8000.0            0.0
      .        .                 .
      .        .                 .
      .        .                 .
    437        32000.0           40000.0
    438        34000.0           40000.0
    439        36000.0           40000.0
    440        38000.0           40000.0
    441        40000.0           40000.0
```

Stratigraphy File Unit 9

The stratigraphy data represents the composition, distribution, and succession of aquifer layers. Each aquifer layer can be classified as confined or unconfined. For a confined layer, information must be provided about confining layer (aquiclude or aquitard). The data file specifies each aquifer layer. The conversion factor in the data file converts elevations and thicknesses to simulation unit of length. Each groundwater node, the ground surface elevation at the groundwater node, and the thickness of each layer (and corresponding confining layer) at each node are required stratigraphy input data.

If the thickness of the aquiclude or aquitard is set to zero, there is no separating confining layer that distinguishes an aquifer layer from the adjacent layer. If thickness of an aquifer layer is set to zero, this implies that the groundwater node at that aquifer layer is an inactive node and the aquifer layer does not exist at that location. The following input is required in the stratigraphy data file:

NL	Number of groundwater layers modeled in IWFM; each layer consists of an aquifer and aquiclude or aquitard
FACT	Factor to convert stratigraphic data from user input units to the simulation unit of length
ID	Groundwater node
ELV	Ground surface elevation relative to a common datum, [L]
W	Thickness of the aquifer layer, and its confining layer (if the layer is confined). If the layer is unconfined, specify the aquitard thickness as zero

```
C*******************************************************************************
C
C                    INTEGRATED WATER FLOW MODEL (IWFM)
C                           *** Version ### ***
C
C*******************************************************************************
C
C                           STRATIGRAPHY FILE
C                        for IWFM Pre-Processing
C                               (Unit 9)
C
C
C             Project:  IWFM Version ### Release
C                       California Department of Water Resources
C             Filename: STRATA.DAT
C
C*******************************************************************************
C                          File Description
C
C   This data file contains:
C   *the ground surface elevation,
C   *the number of aquifer layers to be modeled, and
C   *the thickness of each aquifer and corresponding confining layer (if any)
C   at each groundwater node within the model domain.
C
C*******************************************************************************
C                   Stratigraphy Specification Data
C
C   NL;    Number of layers to be modeled
C   FACT;  Conversion factor for elevations and thicknesses in the
C          stratigraphic data
C-------------------------------------------------------------------------------
C   VALUE                        DESCRIPTION
C-------------------------------------------------------------------------------
    2                          /NL
    1.0                        /FACT
C-------------------------------------------------------------------------------
C*******************************************************************************
C                         Stratigraphy Data
C
C  *The stratigraphy data represents the geology that deals with the origin,
C   composition, distribution and succession of groundwater layers.
C
C  *Each groundwater layer is specified as an aquifer and aquiclude or aquitard.
C   If there is no aquiclude or aquitard within the layer, specify a thickness
C   of zero
C
C  *The stratigraphy data includes the ground surface elevation, as well as the
C   thickness of the aquifer, aquitard, or aquiclude at each groundwater node
C
C   ID;      Groundwater node
C   ELV;     Ground surface elevation with respect to a common datum; [L]
C   W(1);    Thickness of aquiclude in Layer 1; [L]
C   W(2);    Thickness of aquifer in Layer 1; [L]
C   W(3);    Thickness of aquiclude in Layer 2; [L]
C   W(4);    Thickness of aquifer in Layer 2; [L]
C   W(5);    Thickness of aquiclude in Layer 3; [L]
C   W(6);    Thickness of aquifer in Layer 3; [L]
C
C------------------------------------------------------------------------------
C    Node  Elevation   --Layer #1--     --Layer #2--     --Layer #3--   ...
C     ID     ELV        W(1)   W(2)     W(3)    W(4)      W(5)    W(6)  ...
C------------------------------------------------------------------------------
       1    500.0       0.0    500.0    10.0    100.0
       2    500.0       0.0    500.0    10.0    100.0
       3    500.0       0.0    500.0    10.0    100.0
       4    500.0       0.0    500.0    10.0    100.0
       5    500.0       0.0    500.0    10.0    100.0
       .    .           .      .         .      .
       .    .           .      .         .      .
       .    .           .      .         .      .
     436    500.0       0.0    500.0     0.0    100.0
     437    500.0       0.0    500.0     0.0    100.0
     438    500.0       0.0    500.0     0.0    100.0
     439    500.0       0.0    500.0     0.0    100.0
     440    500.0       0.0    500.0     0.0    100.0
     441    500.0       0.0    500.0     0.0    100.0
```

Stream flow is modeled using one-dimensional line segments. The stream configuration data file contains all of the stream nodes and spatial orientation. The data file includes the stream network configuration, which is specified for each reach. Following the stream reach data is the rating table for each of the stream nodes. Based on the rating table values, interpolation is used to determine the stream flow for a specific stream elevation. The following parameters must be specified at the beginning of the stream configuration file for the simulation of stream flows:

NRH	Number of stream reaches modeled
NR	Number of stream nodes modeled
NRTB	Number of data points in each rating table. A rating table is given for each stream node specified within the model domain

Stream Reaches

For each reach of a river, the following items are specified: reach identification number (ID), first upstream node of reach ID, last downstream node of reach ID, and the stream node that reach ID flows into. The stream nodes are then listed, followed by the groundwater node that the stream node corresponds to, and the subregion that the stream node belongs to. The subregion listed for a stream node does not have to be the one that the node physically resides. The subregion numbers are used solely for grouping and reporting the simulation output. For instance, a particular stream node may physically reside in one subregion but, for operational or management purposes, it may be reported in another subregion.

If flow from a stream reach contributes to a lake, then the lake number preceded by a negative sign should be entered for variable IDWN. The lake numbers are listed in the lake data file. Such a set-up is different than a set-up where recoverable losses from a by-pass (see Simulation part of this manual) flow into a lake. By-pass flows are computed before stream-groundwater interaction is calculated. In the former case, all flows at the reach, including the stream-groundwater interaction, will contribute to lake storage. However, in the latter case, stream-groundwater interaction will be excluded from the amount of flow that contributes to the lake.

The following parameters are specified in the stream reach specification portion of Unit 10:

ID	Reach identification number
IBUR	First upstream node of reach ID
IBDR	Last downstream node of reach ID
IDWN	Stream node that reach ID flows into (enter zero if stream flow leaves the modeled area; enter –nlk if stream flow enters lake number nlk)
IRV	Stream node number
IGW	Groundwater node that the stream node IRV corresponds to
IRGST	Subregion that the stream node IRV belongs to

Rating Table

Each stream node and corresponding stream bottom elevation are specified in this file, along with a rating table for each stream node that specifies the flow rate for various stream elevations. The purpose of a rating table is to determine stream flow rate, given a specific stream elevation. Factors to convert stream depths and stream bottom elevations to simulation unit of length and stream flows to simulation unit of flow rate are required.

FACTLT	Factor to convert stream bottom elevation and depth to simulation unit of length
FACTQ	Factor to convert the spatial component of the rating table flow rates into simulation unit of volume. For instance, if the rating table flow rates are given in ac.ft./month and the consistent simulation units for volume and time are cu.ft. and day, respectively, then this variable should be set to 2.29568E-05 (to convert ac.ft./month to cu.ft./month). The conversion of cu.ft./month to cu.ft./day is performed dynamically in the Simulation part since each month has a different number of days. This variable can also be used to convert flow rate units that are not recognized by IWFM to units that are recognized. For instance, if the flow rates are given in units of cfs (IWFM doesn't recognize second as a unit of time), this variable can be set to 60 to convert cfs into cu.ft./min and variable TUNIT can be set to 1MIN.
TUNIT	Time unit of the rating table flow rates
ID	Stream node number
BOTR	Stream bottom elevation relative to a common datum, [L]
HRTB	Stream depth, [L]
QRTB	Flow rate at stream depth HRTB, [L^3/T]

```
C*******************************************************************************
C
C                    INTEGRATED WATER FLOW MODEL (IWFM)
C                           *** Version ### ***
C
C*******************************************************************************
C
C                       STREAM SPECIFICATION FILE
C                        for IWFM Pre-Processing
C                              (Unit 10)
C
C
C             Project:  IWFM Version ### Release
C                       California Department of Water Resources
C             Filename: STREAM.DAT
C
C*******************************************************************************
C                             File Description
C
C   *All stream/river nodes modeled in IWFM are specified with respect to their
C    corresponding groundwater nodes
C
C   *A flow versus depth rating table is specified for each stream node
C
C*******************************************************************************
C                      Stream Reach Specifications
C
C   NRH;   Number of stream reaches modeled
C   NR;    Number of stream nodes modeled
C   NRTB;  Number of data points in stream rating tables
C
C-------------------------------------------------------------------------------
C   VALUE                       DESCRIPTION
C-------------------------------------------------------------------------------
    3                           / NRH
    23                          / NR
    5                           / NRTB
C-------------------------------------------------------------------------------
C*******************************************************************************
C                       Description of Stream Reaches
C
C   The following lists the stream nodes and corresponding groundwater
C   nodes for each stream reach modeled in IWFM.
C
C   ID;    Reach number
C   IBUR;  First upstream stream node of the reach
C   IBDR;  Last downstream node of the reach
C   IDWN;  Stream node into which the reach flows into
C              0: If stream flow leaves the modeled area
C           -nlk: If stream flows into lake number nlk
C
C   In addition, for each stream node within the reach the corresponding
C   groundwater node and subregion number is listed.
C
C   IRV;   Stream node
C   IGW;   Corresponding groundwater node
C   IRGST; Corresponding subregion number
C
C-------------------------------------------------------------------------------
C     REACH  1
C   Reach  Upstream  Downstream  Outflow
C           Node       Node      Node
C   ID      IBUR       IBDR      IDWN
C-------------------------------------------------------------------------------
     1        1          10       -1
C-------------------------------------------------------------------------------
C   Stream  Groundwater  Subregion
C   node      node       number
C   IRV       IGW        IRGST
C-------------------------------------------------------------------------------
     1       433         2
     2       412         2
     .        .          .
     .        .          .
     .        .          .
     9       265         2
    10       264         2
C-------------------------------------------------------------------------------
C     REACH 2
C   Reach  Upstream  Downstream  Outflow
C           Node       Node      Node
C   ID      IBUR       IBDR      IDWN
C-------------------------------------------------------------------------------
     2       11         16        17
C-------------------------------------------------------------------------------
C   Stream  Groundwater  Subregion
C   node      node       number
C   IRV       IGW        IRGST
C-------------------------------------------------------------------------------
    11       222         2
```

```
     .       .           .
     .       .           .
    16       139         1
C-------------------------------------------------------------------------------
C     REACH  3
C   Reach  Upstream  Downstream  Outflow
C           Node       Node      Node
C   ID      IBUR       IBDR      IDWN
C-------------------------------------------------------------------------------
     3       17         23        0
C-------------------------------------------------------------------------------
C   Stream  Groundwater  Subregion
C   node       node       number
C   IRV        IGW        IRGST
C-------------------------------------------------------------------------------
    17       139         1
     .       .           .
     .       .           .
     .       .           .
    23       13          1
C*******************************************************************************
C                             Stream rating tables
C
C   FACTLT; Conversion factor for stream bottom elevation and stream depth
C   FACTQ;  Conversion factor for rating table flow rates
C             It is used to convert only the spatial component of the unit;
C             DO NOT include the conversion factor for time component of the unit.
C             * e.g. Unit of flow rate listed in this file      = AC.FT./MONTH
C                    Consistent unit used in simulation         = CU.FT/DAY
C                    Enter FACTQ (AC.FT./MONTH -> CU.FT./MONTH) = 2.29568E-05
C                     (conversion of MONTH -> DAY is performed automatically)
C   TUNIT;  Time unit of flow rate.  This should be one of the units
C             recognized by HEC-DSS that are listed in the Simulation Main
C             Control File.
C
C-------------------------------------------------------------------------------
C   VALUE                       DESCRIPTION
C-------------------------------------------------------------------------------
      1.0                       / FACTLT
      60.0                      / FACTQ  [cfs -> cu.ft/min since seconds cannot be represented in Simulation]
      1MIN                      / TUNIT
C-------------------------------------------------------------------------------
C   The following lists a stream rating table for each of the stream nodes
C   *Note* In order to define a specified stream depth, enter all HRTB values
C             as equal to the specified depth value
C
C   ID;    Stream node number
C   BOTR;  Stream bottom elevation relative to a common datum [L]
C   HRTB;  Stream depth [L]
C   QRTB;  Flow rate at stream depth HRTB [L^3/T]
C
C-------------------------------------------------------------
C   Stream    Bottom   Stream      Flow
C   node     elevation  depth      rate
C   ID         BOTR     HRTB       QRTB
C-------------------------------------------------------------
     1       300.0     0.0       0.00
                       2.0       734.94
                       5.0       3299.29
                       15.0      19033.60
                       25.0      41568.45
     2       298.0     0.0       0.00
                       2.0       734.94
                       5.0       3299.29
                       15.0      19033.60
                       25.0      41568.45
     3       296.0     0.0       0.00
                       2.0       734.94
                       5.0       3299.29
                       15.0      19033.60
                       25.0      41568.45
     .       .         .         .
                       .         .
                       .         .
     .       .         .         .
                       .         .
                       .         .
    23       260.0     0.0       0.00
                       2.0       734.94
                       5.0       3299.29
                       15.0      19033.60
                       25.0      41568.45
```

Lake Configuration File Unit 11

The lake data file specifies the number of lakes modeled and the total number of lake elements. Each lake is specified by an identification number. The identification number of the next downstream lake for each lake is required, followed by the number of elements that each lake encompasses and the element numbers that correspond to the lake region. The following lists the lake input:

NLAKE	Number of lakes modeled
NTELAKE	Total number of lake elements
ID	Lake identification number
INLAKE	Lake identification number of the next downstream lake. Enter 0 (zero) if flow from lake leaves the modeled area, -nd if flow from lake goes to stream node nd, or nd if flow from lake goes to the downstream lake nd
NELAKE	Number of elements that a lake encompasses
IELAKE	Element number over which the lake is located

```
C*******************************************************************************
C
C                    INTEGRATED WATER FLOW MODEL (IWFM)
C                           *** Version ### ***
C
C*******************************************************************************
C
C                   LAKE CONFIGURATION DATA FILE
C                     for IWFM Pre-Processing
C                            (Unit 11)
C
C
C             Project:  IWFM Version ### Release
C                       California Department of Water Resources
C             Filename: LAKE.DAT
C
C*******************************************************************************
C
C                             File Description:
C
C   This data file contains the number of lakes being modeled,
C   next downstrem lake and the finite elements included in each lake.
C
C*******************************************************************************
C                  Lake Configuration Data
C
C   NLAKE  ; Number of lakes that are being modeled
C   NTELAKE; Total number of lake elements
C
C-------------------------------------------------------------------------------
C   VALUE                         DESCRIPTION
C-------------------------------------------------------------------------------
      1                           / NLAKE
      10                          / NTELAKE
C-------------------------------------------------------------------------------
C
C   The following lists the area and elevation for the NLAKE number of lakes
C
C   ID    ;  Sequential number for the lakes
C   INLAKE;  Next downstream lake number
C              0 : if flow from lake leaves the modeled area
C            -nd : if flow from lake goes to stream node nd
C             nd : if flow from lake goes to the downstream lake, nd
C   NELAKE;  Number of lake elements where lake lies
C   IELAKE;  Element in which the lake is located
C----------------------------------------------------------------------
C   Lake No.    Next Lake  Elem per Lake   Element
C     ID         INLAKE       NELAKE        IELAKE
C----------------------------------------------------------------------
      1           -11          10           169
                                            170
                                            171
                                            188
                                            189
                                            190
                                            207
                                            208
                                            209
                                            210
```

Well Data File **Unit 12**

The location and characteristics of wells are specified in the well data file. Similar to the nodal coordinates data file (Unit 8), each well identification number corresponds to a location based on an x and y coordinate. The x and y coordinates can be input with any units, as long as the correct conversion factor (FACTCX) is given in the file. Other required input for each well is the diameter and the elevation of the top and bottom perforations in the well. Factors to convert the diameter and elevations from input units to simulation units are also required. The following list of variables is required input data, given that pumping and recharge are defined on the basis of well locations:

NWELL	Number of wells modeled
FACTCX	Conversion factor for well coordinates
FACTRW	Factor to convert well diameter to simulation unit of length
FACTLT	Factor to convert perforation depths to simulation unit of length
ID	Well identification number
XWELL	x coordinate of well ID, [L]
YWELL	y coordinate of well ID, [L]
RWELL	Well diameter, [L]
PERFT	Elevation of the top perforation, [L]
PERFB	Elevation of bottom perforation, [L]

```
C*******************************************************************************
C
C                    INTEGRATED WATER FLOW MODEL (IWFM)
C                           *** Version ### ***
C
C*******************************************************************************
C
C                          WELL SPECIFICATION FILE
C                         for IWFM Pre-Processing
C                                 (Unit 12)
C
C
C             Project:  IWFM, Version ### Release
C                       California Department of Water Resources
C             Filename: WELL.DAT
C
C*******************************************************************************
C                             File Description:
C
C   This data file includes the identification number, location(x-y coordinates),
C   radius, and depth of perforations for each well.
C
C*******************************************************************************
C               List of modeled wells and their corresponding parameters
C
C   NWELL ; Number of wells modeled
C   FACTCX; Conversion factor for well coordinates
C   FACTRW; Conversion factor for well diameter
C   FACTLT; Conversion factor for perforation depths
C
C-------------------------------------------------------------------------------
C     VALUE                       DESCRIPTION
C-------------------------------------------------------------------------------
      5                         / NWELL
      1000.0                    / FACTCX
      1.0                       / FACTRW
      1.0                       / FACTLT
C-------------------------------------------------------------------------------
C*******************************************************************************
C
C   ID;           Well identification number
C   XWELL,YWELL;  X-Y coordinates for each well; [L]
C   RWELL;        Well diameter; [L]
C   PERFT,PERFB;  Elevations of the top and bottom perforations; [L]
C
C-------------------------------------------------------------------------------
C    ID      XWELL  YWELL      RWELL       PERFT   PERFB
C-------------------------------------------------------------------------------
     1        25.0     7.0        1.0       400.0   0.0
     2        26.0    12.0        1.0       400.0   0.0
     3        25.0    19.0        1.0       400.0   0.0
     4        26.0    26.0        1.0       400.0   0.0
     5        25.0    33.0        1.0       400.0   0.0
```

Element Characteristics File Unit 13

The element characteristics file contains hydrologic characteristics of an element. The rainfall station and the fraction of the precipitation measured at the station determine the precipitation on an element. The rainfall station is associated with an element based on location. The rainfall factor is a weighted average of the long term mean annual precipitation at an element and the long term average annual precipitation associated with the corresponding rainfall station. If zero is entered for the rainfall stations for all the elements, then IWFM can be used to model only the groundwater system, streams and lakes without simulating any land processes (i.e. infiltration, evapotranspiration, direct runoff of precipitation and return flow of applied water). Otherwise, a non-zero station identification number must be entered for all elements.

The hydrologic soil properties of the elements are based on National Resources Conservation Service (previously known as Soil Conservation Service) soil reports. Refer to the National Engineering Handbook, Section 4 published by the USDA (1985) for more detail. NRCS classifies four soil groups, termed A, B, C, and D. The four soil groups represent the following runoff characteristics:

- Soil Group A Soils (sands and gravels) with high transmissivity, therefore having a high infiltration rate, and low runoff potential (A=1)
- Soil Group B Usually a mixture of fine and coarse textured soils with moderate transmissivity (and infiltration rates), therefore they have a low to moderated runoff potential (B=2)

- Soil Group C — Fine texture soils with low transmissivity rates and slow infiltration rates, which leads to moderate to high runoff potential (C=3)
- Soil Group D — Semi-pervious to impervious soils (i.e. clay) that have high runoff potential (D=4)

If a non-integer value is entered for the soil type at an element, IWFM rounds it to the nearest integer and uses it as the soil group number for the element. The drainage node related to each element routes the runoff from an element to a stream node. Several elements can drain to a single stream node. Drainage is highly dependent on the topography of the study area. If a value of zero is entered for drainage node then it is assumed that the surface flow leaves the modeled area.

Unit 13 also denotes the subregion and sub-group each element is associated with. Subregions and sub-groups contain multiple elements and are predominantly defined for reporting purposes. Much of the post-processing is tabulated by subregion.

The following list defines the input variables specified in Unit 13:

IE	Element number
IRNE	Rainfall station assigned to element IE
FRNE	Factor to convert rainfall at rainfall station IRNE to rainfall at element IE
ISTE	Stream node that the surface runoff from element IE drains to (enter zero if surface flow from element IE leaves the modeled area)
IRGE	Subregion number corresponding to element IE

ISGE	Sub-element group corresponding to element IE
ISOILE	Hydrologic soil information of element IE

```
C*******************************************************************************
C
C                     INTEGRATED WATER FLOW MODEL (IWFM)
C                            *** Version ### ***
C
C*******************************************************************************
C
C                      ELEMENT CHARACTERISTICS DATA FILE
C                          for IWFM Pre-Processing
C                                  (Unit 13)
C
C
C             Project:  IWFM Version ### Release
C                       California Department of Water Resources
C             Filename: ELEMCHRC.DAT
C
C*******************************************************************************
C                             File Description
C
C   This data file contains the hydrologic characteristics of each element
C   including the rainfall station to be used, a rainfall factor  to relate
C   rainfall at the element to the rainfall station, stream node where
C   runoff drains to, the sub-region corresponding to the element, and the
C   hydrologic soil type.
C
C*******************************************************************************
C                        Element Characteristics Data
C
C   The following lists the hydrologic characteristics of each element:
C
C   IE;      Element number
C   IRNE;    Rainfall station assigned to the element IE
C             (enter zero for all elementsif no land processes other than
C              streams and lakes are modeled)
C   FRNE;    Factor to convert rainfall at the assigned rainfall station to
C            rainfall at the element IE
C   ISTE;    Stream node to which surface water from element IE drains to
C             (enter zero if the surface flow from element IE leaves the model area)
C   IRGE;    Subregion number to which element IE belongs to
C   ISGE;    Element sub-group number to which element IE belongs to
C   ISOILE;  Hydrologic soil property of the element (ie. A=1, B=2, C=3, D=4)
C            (Reference for A-D soil types: USDA, 1985)
C
C-------------------------------------------------------------------------------
C   Element   Rainfall   Rainfall    Drainage   Subregion  Element   Soil
C             station    factor      node                  sub-grp   type
C     IE       IRNE       FRNE        ISTE       IRGE       ISGE    ISOILE
C-------------------------------------------------------------------------------
      1          1          1.0         18          1         2       1
      2          1          1.0         18          1         2       1
      3          1          1.0         18          1         2       1
      4          1          1.0         18          1         2       1
      5          1          1.0         18          1         2       1
      .          .          .           .           .         .       .
      .          .          .           .           .         .       .
      .          .          .           .           .         .       .
    396          2          1.0         6           2         1       1
    397          2          1.0         6           2         1       1
    398          2          1.0         6           2         1       1
    399          2          1.0         6           2         1       1
    400          2          1.0         6           2         1       1
```

3.3. Output Files

Binary Output File — Unit 4

The binary file contains the pre-processing information used in the simulation portion of IWFM. The file is generated in the pre-processor program, and must be copied to the folder with the IWFM simulation executable program.

ASCII Output File (PreprocessorMessages.out)

The ASCII output file provides the user with information that was processed in the pre-processor portion of IWFM. The following list indicates the information available in this output file:

- Project title (specified in Unit 5)
- Date and time of run, which is determined internally within the program
- List of input files read in the pre-processing program
- Various warning and/or error messages
- Subregional areas
- Number of nodes, triangular elements, quadrilateral elements and groundwater layers
- Nodal x-y coordinates and areas associated with each node
- Elements, corresponding nodes, and elemental areas
- Top and bottom elevations of aquifer layers
- IUD variable at a node of an aquifer layer

IUD = 1 : the node is active; i.e. the aquifer layer exists at the particular node

IUD = –99 : the node is inactive; i.e. the aquifer layer thickness is zero and the layer does not exist at the particular node

- Stream reach information
- Well characteristics
- Number of active layers at each node
- Node numbers surrounding each groundwater node
- Non-zero components of conductance matrix

```
*************************************************************************************************************************
                                                         IWFM
                                                   Version ### Release
                                                          DWR
*************************************************************************************************************************

THIS RUN IS MADE ON 01/23/2007 AT 15:07:39

THE FOLLOWING FILES ARE USED IN THIS SIMULATION:
   4  OUTPUT1.BIN                                        01/23/2007  02:05
   5  MAIN.IN1                                           01/23/2007  02:15
   6  OUTPUT1.OUT
   7  ELEMENT.DAT                                        01/23/2007  02:14
   8  XY.DAT                                             01/23/2007  02:16
   9  STRATA.DAT                                         01/23/2007  02:15
  10  STREAM.DAT                                         01/23/2007  02:16
  11  LAKE.DAT                                           01/23/2007  02:15
  12
  13  ELEMCHRC.DAT                                       01/23/2007  02:14

REGION =   1    18365.60  ACRES
REGION =   2    18365.60  ACRES
      TOTAL     36731.20  ACRES

NO. OF NODES                          ( ND):       441
NO. OF TRIANGULAR ELEMENTS            (NET):         0
NO. OF QUADRILATERAL ELEMENTS         (NEQ):       400
NO. OF TOTAL ELEMENTS                 ( NE):       400
NO. OF LAYERS                         ( NL):         2
SUM OF CONNECTING NODES FOR EACH NODE ( NJ):      9335


 NODE           X             Y      AREA(ACRES)
    1         0.00          0.00        22.96
    .           .             .            .
    .           .             .            .
    .           .             .            .
  441     40000.00      40000.00        22.96


 ELEMENT          NODE         AREA(ACRES)
     1      1    2   23   22       91.83
     .      .    .    .    .          .
     .      .    .    .    .          .
     .      .    .    .    .          .
   400    419  420  441  440       91.83


    *** TOP AND BOTTOM ELEVATIONS OF AQUIFER LAYERS (FEET) ***
  NODE  GRND.SURF.          LAYER  1                    LAYER  2
                  IUD       TOP     BOTTOM    IUD        TOP     BOTTOM
     1      500.00    1     500.00      0.00      1      -10.00    -110.00
     .           .    .          .         .      .          .          .
     .           .    .          .         .      .          .          .
     .           .    .          .         .      .          .          .
   441      500.00    1     500.00      0.00      1        0.00    -100.00

REACH STREAM GRID     GROUND  INVERT            AQUIFER  ALLUVIAL    REGION     UPSTREAM  DOWNSTREAM  UPSTREAM
  NO.   NO.   NO.     ELEV.    ELEV.     DEPTH   BOTTOM  THICKNESS    NO.          ID         ID         NODES
                          (ALL UNITS ARE IN FEET)
     1     1   433     500.0    300.0    200.0       0.0     300.0        2          2          0
     1     2   412     500.0    298.0    202.0       0.0     298.0        2          0          0           1
     .     .     .         .        .        .         .         .        .          .          .           .
     .     .     .         .        .        .         .         .        .          .          .           .
     .     .     .         .        .        .         .         .        .          .          .           .
     3    22    34     500.0    262.0    238.0       0.0     262.0        1          0          0          21
     3    23    13     500.0    260.0    240.0       0.0     260.0        1          0          1          22

***** THERE ARE NO WELLS *****


 NODE   # OF LAYERS   TOP NODE   SURROUNDING GW NODES
    1            2          1      2   23   22
    .            .          .      .    .    .    .    .
    .            .          .      .    .    .    .    .
    .            .          .      .    .    .    .    .
  441            2        441    440  419  420


 ELEMENT               ELEMENT MATRIX COMPONENTS
     1        -0.17     -0.33     -0.17     -0.17     -0.33     -0.17
     .            .         .         .         .         .         .
     .            .         .         .         .         .         .
     .            .         .         .         .         .         .
   400        -0.17     -0.33     -0.17     -0.17     -0.33     -0.17
**************************************************
 TOTAL RUN TIME:    0 MINUTES  0.12 SECONDS
**************************************************
```

4. Simulation

The simulation portion of IWFM models the groundwater flow and related processes within the project domain for a simulation time period. This chapter details the structure of the simulation program and the input and output files associated with this portion of the program.

4.1. Subroutine Descriptions

The simulation program is a procedural Fortran program, and consists of a main program which calls several subroutines that simulate groundwater flow and other related hydrologic processes (Figure 4.1). This section describes each subroutine.

Iwfm_f2 This is the main subroutine that controls the simulation process and calls the subroutines listed below.

GetMainControlData This subroutine reads the main control input data and initializes the input and output files.

Array_allocate This subroutine reads in data from input data files and allocates array dimensions.

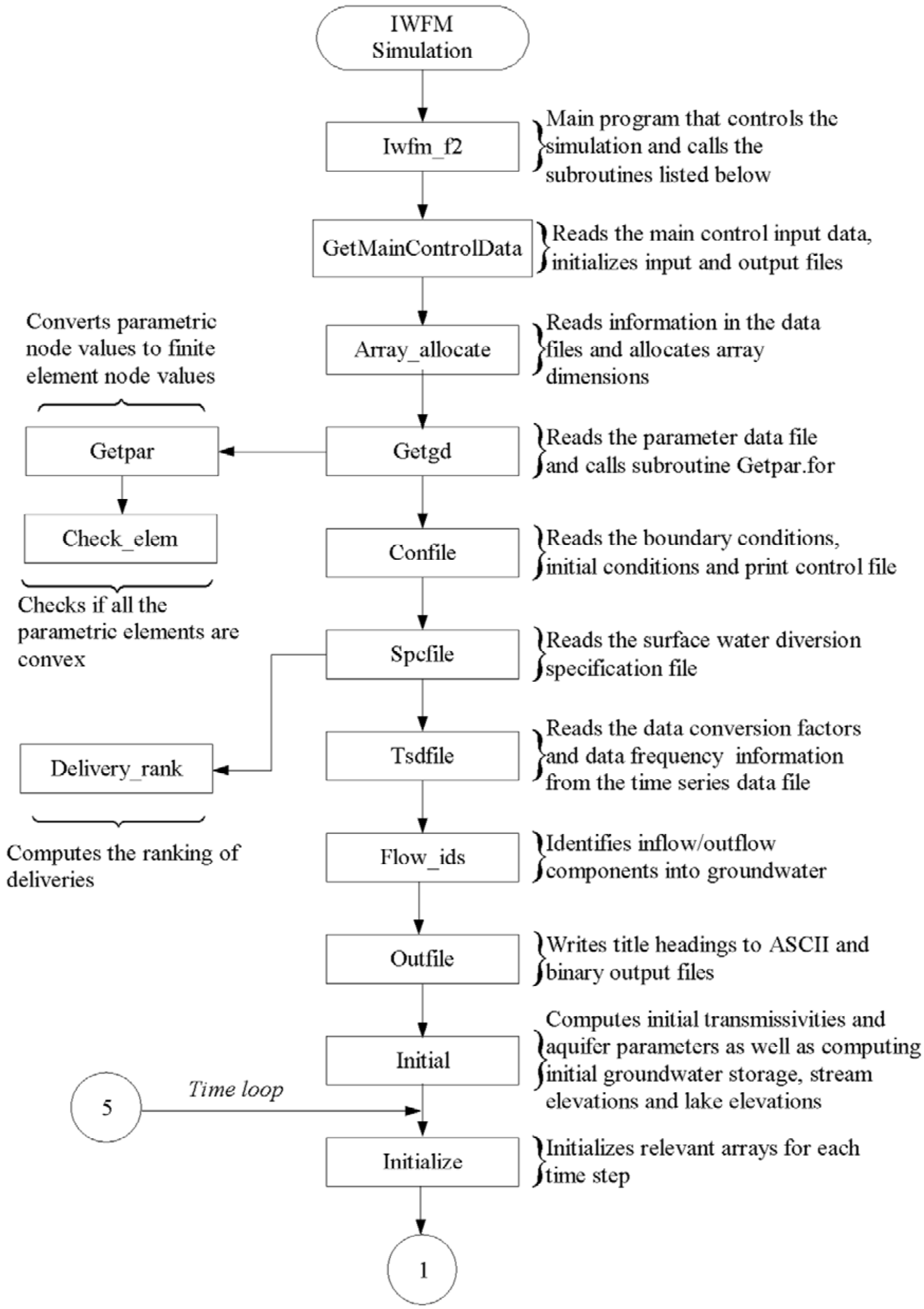


Figure 4.1 IWFM Simulation subroutines

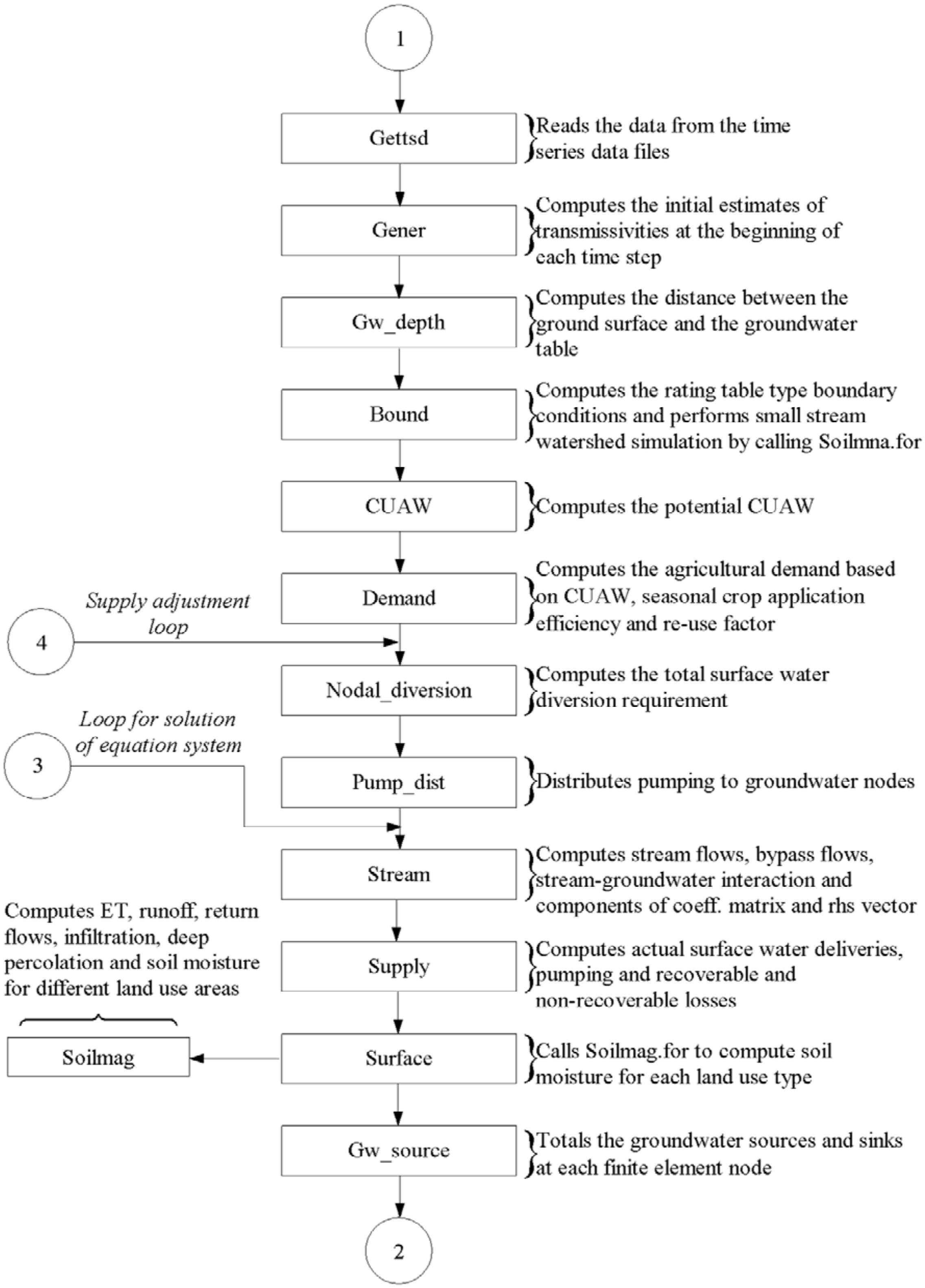


Figure 4.1 IWFM Simulation subroutines *(continued)*

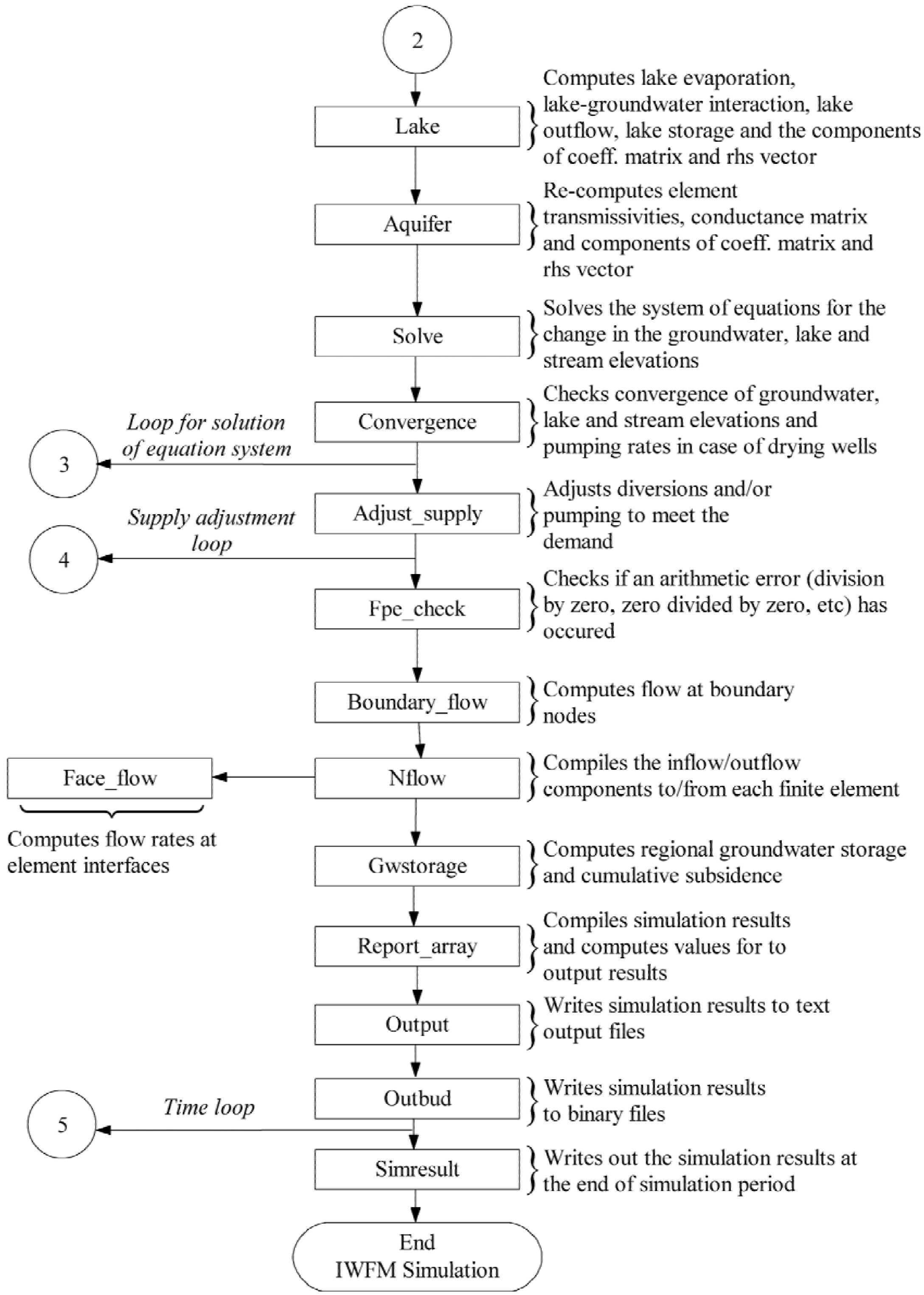


Figure 4.1 IWFM Simulation subroutines *(continued)*

Getgd This subroutine reads the information stored in the binary file generated during the execution of Pre-processor, reads in parameter data file and calls subroutine Getpar to convert parametric grid information to correspond to the finite element mesh of the project domain.

Getpar Converts parametric node values to finite element node values.

Check_elem This subroutine checks that all the parametric elements specified in the parameter file are convex, i.e. the internal angles at the nodes of an element are all less than 180 degrees.

Confile This subroutine reads the following input data files: boundary conditions, print control file and initial conditions.

Spcfile This subroutine reads the surface water diversion specification file and finds the ranking of the deliveries to be used for the surface water diversions adjustment feature by calling the subroutine Delivery_rank.

Delivery_rank Computes the ranking of the deliveries to be used for the surface water diversions adjustment feature.

Tsdfile This subroutine reads in the data conversion factors and data frequency information from each of the time series input file.

Flow_ids This subroutine identifies the different sources of inflow/outflow components to/from the aquifer system based on the hydrologic processes included in the simulation. This information is used when detailed inflow/outflow components are printed for each sub-domain by the Z-Budget post-processor.

Outfile This subroutine writes title headings to ASCII and binary simulation output files.

Initial This subroutine computes the initial transmissivities, storativities, vertical leakances and pre-compaction head values for groundwater nodes within the model domain. It also computes regional groundwater storage, soil moisture content in the unsaturated zone. Finally, it sets the initial stream elevations and computes lake storages.

Initialize This subroutine initializes relevant arrays for each time step.

Gettsd This subroutine reads the following time series data files: subregional crop and non-agricultural land use areas, elemental land use areas, pumping specifications and time-series pumping data, surface water diversions, irrigation fractions, supply adjustment specifications, stream flows, precipitation, evapotranspiration, agricultural demand or agricultural demand parameters, urban water use specifications, urban water demand and time series boundary conditions data.

Gener This subroutine computes the initial estimate of transmissivities at the beginning of each time step except the first time step. The initial estimates of transmissivities for the first time step is computed in Initial.

Gw_depth This subroutine computes the distance between the ground surface and the groundwater table.

Bound This subroutine computes the rating table type boundary condition and performs the small stream watershed simulation in conjunction with Soilmna.

CUAW This subroutine computes the potential consumptive use of applied water based on the available soil moisture, precipitation, crop evapotranspiration and minimum soil moisture requirement.

Demand This subroutine computes the agricultural water demand based on the potential consumptive use of applied water, seasonal crop application efficiency and re-use factor.

Nodal_diversion This subroutine computes the total surface water diversion requirement at each stream node based on the surface water diversion specifications and diversion data.

Pump_dist Depending on the type of pumping data entered (well pumping or elemental pumping) this subroutine either distributes pumping from well locations to surrounding nodes or pumping from elements to corresponding nodes.

Stream This subroutine computes stream flows, bypass flows, actual diversion amounts, diversion shortgaes and stream-groundwater interaction based on the estimate of the stream surface elevations. It also computes the relevant components of the coefficient matrix and the right-hand-side vector that are used in the solution of the system of non-linear equations.

Supply This subroutine computes the actual surface water deliveries to urban and agricultural areas, recoverable losses and non-recoverable losses from surface water diversion and bypass processes as well as the amount of pumping from groundwater that is delivered to agricultural and urban lands.

Surface This subroutine includes subregional soil moisture computations for the root zone and elemental soil moisture computations for the unsaturated zone. Soil moisture computations differ slightly for native and riparian lands than agricultural and urban lands because of the computations due to the application of water to agricultural and urban lands. Therefore, subroutine Soilmag is called to perform soil moisture computations of the agricultural and urban areas whereas Soilmna is called to compute soil moisture in native and riparian areas.

Soilmag This subroutine computes ET, runoff, return flows, infiltration, deep percolation and soil moisture in agricultural, urban, native vegetation and riparian vegetation lands within the modeled area.

Gw_source This subroutine totals the groundwater sources and sinks at each finite element node.

Lake This subroutine computes lake evaporation, lake-groundwater interaction, lake overflow and lake storage based on the estimate of the lake surface elevation. It also computes the relevant components of the coefficient matrix and the right-hand-side vector that are used in the solution of the system of non-linear equations.

Aquifer This subroutine re-computes the element transmissivities, and the conductance matrix. It also computes the relevant components of the coefficient matrix and the right-hand-side vector that are used in the solution of the system of non-linear equations.

Solve This subroutine solves the system of equations using the coefficient matrix and the right-hand-side vector whose components are computed in Stream, Lake and Aquifer. The solution of the system of equations results in the changes in the estimated groundwater, stream and lake elevations.

Convergence This subroutine checks if the changes in the estimated groundwater, stream and lake elevations computed in Solve are smaller than a user-specified tolerance. It also checks if the aquifer at any node dries up due to pumping during the time step. If so, pumping rates are readjusted for the computation of the actual amount of water that is pumped from a drying well.

Adjust_supply This subroutine adjusts, per user's request, the stream diversions and/or groundwater pumping to minimize the discrepancy between the agricultural and urban water demand and the water supply.

Fpe_check This subroutine checks if an arithmetic operation that causes a floating point error (division by zero, zero divided by zero, etc.) has occurred during simulation. If such an operation is detected at a time step the simulation results from previous time step are printed out to file Unit 50 and the simulation is aborted.

Boundary_flow This subroutine computes the flow rates at the boundary nodes.

Nflow This subroutine compiles the inflow/outflow terms for each finite element at each aquifer layer and calls the Face_flow subroutine to compute the flow rates at each element interface. This subroutine also prints out the results, i.e. detailed inflow/outflow terms for each element, to the binary file which is later used by Z-Budget post-processor to compute water budgets for sub-domains.

Face_flow This subroutine locally solves the set of equations to compute the element face flows.

Gwstorage This subroutine computes the regional groundwater storage at the end of the time step and the cumulative subsidence.

Report_arrays This subroutine compiles the simulation results and computes the array values that are used in the reporting of the results.

Output This subroutine writes the simulation results to the ASCII output files.

Outbud This subroutine writes the simulation information to binary files that can be used to produce budget tables by running the IWFM budget post-processing program.

Simresult This subroutine writes out the simulation results at the end of the simulation period to an ASCII output file in the same format as the initial conditions input data file.

4.2. Input Files

This section consists of input file explanations, the description of variables in each simulation input file and a sample of each input file. The user should not judge input file spacing based on the sample input files provided in this documentation, instead refer to the input files from a copy of the most recent version of IWFM.

In setting the spatial and temporal input data to be used in IWFM runs, the user is free to specify data with any units as long as the correct conversion factors are specified. IWFM does not use a particular set of units internally. Instead, the user decides on the units to be used and it is the user's responsibility to specify appropriate conversion factors in the input data files to convert a particular data unit to the unit used during simulation. Preparation of each data file includes the entry of relevant conversion factors that need to be specified by the user.

All time series data files require specifying the NSP_ and NFQ_ variables. For instance, in the stream inflow data file (Unit 21) these variables appear as NSPSTRM and NFQSTRM, respectively. These variables are included in time-series data files in order to make the entry of repetitive data more convenient. NSP_ variable is the number of time steps before a particular time-series data is updated. NFQ_ variable is the repetition frequency of the particular data file. As an example, consider monthly evapotranspiration data. In practice, potential evapotranspiration rates change from month to month but they stay the same from one year to another. Therefore, generally one value of ET rate is defined for each month of the year and these values are used for the corresponding months of all simulation years. The repetitive evapotranspiration data entry can be avoided by the use of NSP_ and NFQ_ variables. If IWFM is run on a monthly time step, then NSPET in evapotranspiration data file (Unit 16) can be set as 1, NFQET as 12 and the 12 monthly evapotranspiration rates can be listed afterwards with the first ET data corresponding to the first simulation month. This means that IWFM will read an ET value at the beginning of every time step (NSPET = 1) and when it reads in 12 values

(NFQET = 12) it will rewind the data file and start reading ET values from the beginning of the file.

As another example, consider using the same monthly ET data with a daily IWFM run. Assuming that there are 30 days in each month (IWFM does not make such assumptions internally. It is up to the user to make and defend such assumptions) the same 12-value ET data can be used buy setting NSPET to 30 and NFQET to 12. This time IWFM will read an ET value and use it for 30 time steps (NSPET = 30), i.e. 30 days. At the beginning of the 31st time step, i.e. 31st day, it will read in the next ET value and use it for another 30 time steps. When a total of 12 readings from Unit 16 is made (NFQET = 12), IWFM will rewind the data file and continue reading values from the start of the file. If, on the other hand, the full time series data for the entire simulation period is supplied then NFQ_ variable should be set to zero.

Although NSP_ and NFQ_ values are used only in non-time tracking simulations, the user is required to input a value for these variables in time tracking simulations as well. The following sections give detailed descriptions of each input and output data file involved in simulation part of IWFM.

Main Simulation Input File Unit 5

The main input file for IWFM simulation is similar to the pre-processor main input file, in that it contains the file names for all data files, output files, and binary files as well as unit output specifications. The character ‘c’, ‘C’, or ‘*’, in the first column indicates a comment line in the data file. These characters can not be placed in the first column to be read as input. The title of the model run is specified in this file and is printed in the ASCII output file. The program accepts a maximum of three title lines. The input and output file names and descriptions are included in this file. The simulation period start and time as well as time step length are also specified. The simulation option as time tracking or non-time tracking is specified with the format of the time for the start of the simulation period.

Three output and debugging options are available in IWFM. A value of 2 directs the program to print program execution to the screen. A value of 1 prints aquifer parameter data to the main text output file. Printing the aquifer parameter data is useful during model calibration. Above options can be turned off by specifying KDEB as zero.

Some simulation results can be written to text output files. The information in the output files is displayed based on the unit conversion factors and unit names specified in this input file. The output unit control parameters are used to display the output files in the units specified by the user.

Solution scheme control parameters (namely the solution method, the relaxation parameter, maximum number of iterations and convergence criteria for the solution of equation system, non-linear soil moisture and the supply adjustment) are also specified in this file. The user can choose between two matrix inversion methods, namely the successive overrelaxation (SOR) and the generalized preconditioned conjugate (GMRES) methods. If SOR method is used then the overrelaxation parameter should be set to a value between 1.0 and 2.0. For GMRES method this parameter is not used even though some value has to be entered to avoid immature stopping of the Simulation program. In the situation that the solution of the system of equations or the non-linear conservation equation for soil moisture does not satisfy the specified convergence criteria within the maximum number of iterations set, the user should re-evaluate the convergence criteria and/or maximum number of iterations set. The convergence criteria and the maximum iteration number for the supply adjustment are used if automated supply adjustment is turned on.

The agricultural supply requirement can be specified as input in Unit 19 or obtained based on the potential CUAW computed in IWFM and the efficiencies provided in Unit 22. KOPTDM is specified as zero when the agricultural supply requirement is specified in Unit 19, whereas a value of 1 indicates the agricultural supply requirement is computed based on the values read from input file Unit 22. The functionality of adjusting surface water diversions and/or pumping internally can be activating by setting KOPTDV to a value other than 00.

The following is a list of the variables used in this data file:

BDT	Beginning date and time for the simulation. If it is a time tracking simulation , it should have a MM/DD/YYYY_hh:mm format. If it is a non-time tracking simulation, it should be a real number.
DELTAT	Time step used in the simulation of hydrologic processes. This variable is used only for non-time tracking simulations. At this point, this value is hard coded as 1.0.
UNITT	For time tracking simulation, this is the time step length and unit. The user is expected to choose one of the options listed in the main input file. If non-time tracking simulation, then this is the unit of time step DELTAT with a maximum of 8 characters.

EDT	Ending time of simulation period. If it is a time tracking simulation, it should have the MM/DD/YYYY_hh:mm format. In non-time tracking simulations it is a real number. For instance, assume that BDT is set to 5.0 and DELTAT to 1.0 in a non-time tracking simulation. If the length of simulation period is 100.0 then this variable should be set to 105.0.
KDEB	Switch for output and debugging options (2 = print messages on the screen to monitor execution; 1 = print aquifer parameter data to the standard output file; 0 = turn off output and debugging options)
CACHE	This is the minimum number of simulation results for each time series output data that is stored in the computer memory before saved onto the hard disk. The actual number is specified internally in IWFM based on the characteristics of the output data. For instance, if a model domain has a total of 200 groundwater nodes and if CACHE is set to 2000, then 10 time step worth of groundwater head values will be stored in the memory before being saved onto the hard disk. If CACHE is set to 200, only 1 time step worth of groundwater head values will be stored in the memory. If it is set to 20, still 1 time step worth of head values will be stored in the memory. The value set for the CACHE variable can have a substantial effect on the speed of the simulation especially if DSS files are being used for output.
FACTLTOU	Factor to convert simulation unit of length to output unit of length

UNITLTOU	Output unit of length (maximum 8 characters long)
FACTAROU	Factor to convert simulation unit of area to output unit of area
UNITAROU	Output unit of area (maximum 8 characters long)
FACTVLOU	Factor to convert simulation unit of volume to output unit of volume
UNITVLOU	Output unit of volume (maximum 8 characters long)
FACTVROU	Factor to convert simulation unit of volumetric flow rate into intended output unit of volumetric flow rate
UNITVROU	Output unit of volumetric flow rate (maximum 8 characters long)
MSOLVE	Matrix solution method. Enter 1 to use the successive overrelaxation (SOR) method, or enter 2 to use the generalized preconditioned conjugate method
RELAX	Relaxation parameter for the successive overrelaxation method used in solving the system of equations (value should be between 1.0 and 2.0)
MXITER	Maximum number of iterations for the solution of system of equations
MXITERSM	Maximum number of iterations for the nonlinear soil moisture accounting
MXITERSP	Maximum number of iterations for supply adjustment
STOPC	Convergence criteria for groundwater, stream and lake head difference, [L]
STOPCSM	Convergence criteria for soil moisture, [L]

STOPCSP	Fraction of water demand to be used as a convergence criteria for iterative supply adjustment. If the difference between the water supply and water demand at agricultural and/or urban lands in a subregion is less than the convergence criteria, then supply adjustment is skipped.
KOPTDM	Option to specify the agricultural supply requirement: A value of 0 directs the program to read the agricultural supply requirement from Unit 19. A value of 1 specifies the agricultural supply requirement to be computed in IWFM based on the computed potential CUAW and efficiencies read in Unit 22.
KOPTDV	Switch to turn on/off the automated water supply adjustment functionality of IWFM. It is specified as a two digit number. First digit from left turns on/off adjustment of groundwater pumping (0 = no adjustment; 1 = adjust groundwater pumping). Second digit from left turns on/off the adjustment of surface water diversions (0 = no adjustment for diversions; 1 = adjust diversions so that diversions meet the total water demand less the groundwater pumping; 2 = adjust diversions so that diversions meet the total water demand). If both diversions and pumping are specified to be adjusted, then diversions are adjusted first and pumping is adjusted second. It should be noted that options 11 and 12 result in identical adjusted diversion and pumping values. If KOPTDV is

set to a value other than 00, then file Unit 12 (supply adjustment specification file) should also be supplied.

NCROP — Number of agricultural crops modeled (a value of at least 1 should be entered)

```
C*******************************************************************************
C
C                     INTEGRATED WATER FLOW MODEL (IWFM)
C                            *** Version ### ***
C
C*******************************************************************************
C
C                             MAIN INPUT FILE
C                           for IWFM Simulation
C                                (Unit 5)
C
C
C            Project:  IWFM Version ### Release
C                      California Department of Water Resources
C            Filename: MAIN.IN2
C
C*******************************************************************************
C                               File Description
C
C    This file contains the title of the run to be printed in the output,
C    the names and descriptions of all simulation input files, conversion
C    factors and output control options for running the simulation model.
C
C*******************************************************************************
C                         Titles Printed in the Output
C
C   *A maximum of 3 title lines can be printed.
C   *Do not use '*' , 'c' or 'C' in the first column of the title lines.
C
C                           **********************
                                    IWFM
                            Version ### Release
                                    DWR
C                           **********************
C*****************************************************************************
C                             File Description
C
C  *Listed below are all input and output file names used when running the
C   IWFM simulation.
C
C  *Each file name has a maximum length of 200 characters
C
C  *If a file does not exist for a project, leave the filename blank
C   For example, if tile drains are not modeled in the project, the file name and
C   description columns for unit 17 will appear as:
C
C   FILE NAME                             DESCRIPTION
C                                         /17: TILE DRAINS PARAMETER DATA FILE
C-----------------------------------------------------------------------
C    FILE NAME                            DESCRIPTION
C-------------------------------------------------------------------------------
                                          / 2: ***(Not used in this version)***
                                          / 3: ***(Not used in this version)***
   OUTPUT1.BIN                            / 4: BINARY INPUT GENERATED BY PRE-PROCESSOR (INPUT, REQUIRED)
                                          / 5: ***(Not used in this version)***
                                          / 6: ***(Not used in this version)***
   PARAMETER.DAT                          / 7: PARAMETER DATA FILE (INPUT, REQUIRED)
   BOUND.DAT                              / 8: BOUNDARY CONDITION DATA FILE (INPUT, REQUIRED)
   BOUNDTSD.DAT                           / 9: TIME SERIES BOUNDARY CONDITIONS (INPUT, OPTIONAL)
   PRINT.DAT                              /10: PRINT CONTROL FILE (INPUT, OPTIONAL)
   INIT.DAT                               /11: INITIAL CONDITION DATA FILE (INPUT, REQUIRED)
   SUPADJ.DAT                             /12: SUPPLY ADJUSTMENT SPECIFICATION DATA FILE (INPUT, OPTIONAL)
   LANDUSE.DAT                            /13: LAND USE DATA FILE (INPUT, OPTIONAL)
   CROPAREA.DAT                           /14: CROP ACREAGE DATA FILE (INPUT, OPTIONAL)
   PRECIP.DAT                             /15: PRECIPITATION DATA FILE (INPUT, OPTIONAL)
   ET.DAT                                 /16: EVAPOTRANSPIRATION DATA FILE (INPUT, OPTIONAL)
   TILEDRN.DAT                            /17: TILE DRAINS PARAMETER DATA FILE (INPUT, OPTIONAL)
   URBSPEC.DAT                            /18: URBAN WATER USE SPECIFICATION DATA FILE (INPUT, OPTIONAL)
                                          /19: AGRICULTURAL WATER SUPPLY REQUIREMENT DATA (INPUT, OPTIONAL)
   URBDEMAND.DAT                          /20: URBAN WATER DEMAND FILE (INPUT, OPTIONAL)
   INFLOW.DAT                             /21: STREAM INFLOW DATA FILE (INPUT, OPTIONAL)
   CROPDEMAND.DAT                         /22: CROP DEMAND PARAMETER DATA (Req'd for CUAW est.) (INPUT, OPTIONAL)
   PUMPSPEC.DAT                           /23: PUMPING SPECIFICATION DATA FILE (INPUT, OPTIONAL)
   PUMP.DAT                               /24: PUMPING DATA FILE (INPUT, OPTIONAL)
   DIVERSPEC.DAT                          /25: SURFACE WATER DIVERSION SPECIFICATION FILE (INPUT, OPTIONAL)
   DIVER.DAT                              /26: SURFACE WATER DIVERSION DATA FILE (INPUT, OPTIONAL)
   IRIGFRAC.DAT                           /27: IRRIGATION FRACTION DATA FILE (INPUT, OPTIONAL)
   MAXLKELEV.DAT                          /28: MAXIMUM LAKE ELEVATIONS DATA FILE (INPUT, OPTIONAL)
   RUF.DAT                                /29: IRRIGATION WATER RE-USE FACTOR DATA FILE (INPUT, OPTIONAL)
   OVERWRITE.DAT                          /30: AQUIFER PARAMETER OVER-WRITE DATA FILE (INPUT, OPTIONAL)
   ZBUDGET.BIN                            /31: BINARY OUTPUT FOR GROUNDWATER ZONE BUDGET (OUTPUT,OPTIONAL)
   SMWSHED.BIN                            /32: BINARY OUTPUT FOR SMALL WATERSHED FLOW COMPONENTS (OUTPUT, OPTIONAL)
   SUBGRP.BIN                             /33: BINARY OUTPUT FOR ELEMENT SUB-GROUP DETAILS (OUTPUT, OPTIONAL)
   DIVERDTL.BIN                           /34: BINARY OUTPUT FOR DIVERSION DETAILS (OUTPUT, OPTIONAL)
   REACH.BIN                              /35: BINARY OUTPUT FOR STREAM BUDGET BY REACH (OUTPUT, OPTIONAL)
   LAKE.BIN                               /36: BINARY OUTPUT FOR LAKE BUDGET (OUTPUT, OPTIONAL)
   LWU.BIN                                /37: BINARY OUTPUT FOR LAND AND WATER USE BUDGET (OUTPUT, OPTIONAL)
   STRM.BIN                               /38: BINARY OUTPUT FOR STREAM BUDGET (OUTPUT, OPTIONAL)
   SOIL.BIN                               /39: BINARY OUTPUT FOR ROOT ZONE MOISTURE BUDGET    (OUTPUT, OPTIONAL)
   GW.BIN                                 /40: BINARY OUTPUT FOR GROUNDWATER BUDGET (OUTPUT, OPTIONAL)
   SUBSIDENCE.OUT                         /41: SUBSIDENCE OUTPUT FILE (OUTPUT, OPTIONAL)
   VIRCROP.OUT                            /42: VIRTUAL CROP CHARACTERISTICS OUTPUT FILE (OUTPUT, OPTIONAL)
   FACEFLOW.OUT                           /43: ELEMENT FACE FLOW OUTPUT FILE (OUTPUT, OPTIONAL)
   BNDFLX.OUT                             /44: BOUNDARY FLOW OUTPUT FILE (OUTPUT, OPTIONAL)
   TDRN.OUT                               /45: TILE DRAIN/SUBSURFACE IRRIGATION HYDROGRAPH OUTPUT FILE (OUTPUT,OPTIONA
   STRM.HYD                               /46: STREAM FLOW HYDROGRAPH OUTPUT FILE (OUTPUT, OPTIONAL)
   GW.HYD                                 /47: GW LEVEL HYDROGRAPH OUTPUT FILE (OUTPUT, OPTIONAL)
   GWHEAD.HYD                             /48: GW LEVEL OUTPUT AT EVERY MODEL NODE (OUTPUT, OPTIONAL)
```

```
   VERTFLOW.OUT                            /49: LAYER VERTICAL FLOW OUTPUT (OUTPUT, OPTIONAL)
                                           /50: GROUNDWATER HEADS FOR TECPLOT (OUTPUT, OPTIONAL)
                                           /51: SUBSIDENCE OUTPUT FOR TECPLOT (OUTPUT, OPTIONAL)
   FNRESULTS.OUT                           /52: FINAL SIMULATION RESULTS (OUTPUT, REQUIRED)
C*******************************************************************************
C                         Model Simulation Period
C
C   The following lists the simulation beginning time, ending time and time step length.
C   Based on the entry for BDT below, the actual simulation date and time can be tracked.
C
C   BDT    ; Beginning date and time for the simulation.  Use one of the following formats:
C              MM/DD/YYYY_hh:mm  = Simulation date and time will be tracked
C                                    (Midnight is 24:00);
C              #.##              = Simulation date and time will NOT be tracked
C                                    (any real number greater than or equal to zero can be entered).
C
C-------------------------------------------------------------------------------
C       VALUE                  DESCRIPTION
C-------------------------------------------------------------------------------
        09/30/1973 24:00       / BDT
C-------------------------------------------------------------------------------
C                        Simulation Date and Time Tracked
C
C   If the simulation date and time will be tracked (i.e. BDT above is entered in
C   MM/DD/YYYY hh:mm format) enter values for parameters below.  Otherwise, comment
C   out the value entry lines below and use the "Simulation Date and Time NOT Tracked"
C   option below.
C
C   UNITT  ; Time step length and unit. Choose one of the following:
C                  1MIN
C                  2MIN
C                  3MIN
C                  4MIN
C                  5MIN
C                  10MIN
C                  15MIN
C                  20MIN
C                  30MIN
C                  1HOUR
C                  2HOUR
C                  3HOUR
C                  4HOUR
C                  6HOUR
C                  8HOUR
C                  12HOUR
C                  1DAY
C                  1WEEK
C                  1MON
C                  1YEAR
C   EDT   ; Ending simulation date and time.  Use MM/DD/YYYY_hh:mm format
C             (midnight is 24:00).
C
C-------------------------------------------------------------------------------
C       VALUE                  DESCRIPTION
C-------------------------------------------------------------------------------
        1MON                   / UNITT
        09/30/2003 24:00       / EDT
C-------------------------------------------------------------------------------
C                        Simulation Date and Time NOT Tracked
C
C   If the simulation date and time will not be tracked (i.e. BDT above is entered in
C   #.## format) enter values for parameters below.  Otherwise, comment
C   out the value entry lines below and use the above "Simulation Date and Time Tracked"
C   option.
C
C   DELTAT ; Time step to be used in the simulation of hydrologic processes;
C              any entry that is greater than zero is acceptable.
C   UNITT  ; Unit of time step DELTAT (maximum 8 characters);
C              any entry is acceptable.
C   EDT    ; Ending simulation date and time.  Use #.## format.
C
C-------------------------------------------------------------------------------
C       VALUE                  DESCRIPTION
C-------------------------------------------------------------------------------
*                              / DELTAT
*                              / UNITT
*                              / EDT
C***********************************************************************************
C                         Output and Debugging Options
C
C   The following lists the options for detailed output and debugging.
C   KDEB;    Enter 2 - to print messages on the screen to monitor execution
C            Enter 1 - to print aquifer parameter data
C            Enter 0 - otherwise
C   CACHE;   Cache size in terms of number of values stored for time series data output
C
C-----------------------------------------------------------------------------------
C   VALUE                      DESCRIPTION
C-------------------------------------------------------------------------------
      0                        / KDEB
      50000                    / CACHE
C******************************************************************************
C                  Output Unit Control
C
C    FACTLTOU; Factor to convert simulation unit of length into intented output unit of length
C    UNITLTOU; Output unit of length (max. 8 characters long)
C    FACTAROU; Factor to convert simulation unit of area into intended output unit of area
C    UNITAROU; Output unit of area (max. 8 characters long)
```

```
C    FACTVLOU; Factor to convert simulation unit of volume into intended output unit of volume
C    UNITVLOU; Output unit of volume (max. 8 characters long)
C    FACTVROU; Factor to convert simulation unit of volumetric flow rate into intended output
C               unit of volumetric flow rate
C    UNITVROU; Output unit of volumetric flow rate (max. 8 characters long)
C
C-----------------------------------------------------------------------------
C    VALUE                     DESCRIPTION
C-----------------------------------------------------------------------------
    1.0                        / FACTLTOU
    FEET                       / UNITLTOU
    0.000022957                / FACTAROU
    ACRES                      / UNITAROU
    0.000022957                / FACTVLOU
    AC.FT.                     / UNITVLOU
    0.000022957                / FACTVROU
    AC.FT/D                    / UNITVROU
C*******************************************************************************
C                           Solution Scheme Control
C
C   The following lists the solution scheme control parameters used in SIMULATION
C
C   MSOLVE  ; Matrix solution method
C               1 = SOR method
C               2 = Generalized preconditioned conjugate method
C   RELAX   ; Relaxation parameter for SOR (value should be between 1.0 and 2.0)
C   MXITER  ; Maximum number of iterations for the solution of system of equations
C   MXITERSM; Maximum number of iterations for the nonlinear soil moisture accounting
C   MXITERSP; Maximum number of iterations for supply adjustment
C   STOPC   ; Convergence criteria for groundwater, stream and lake head difference; [L]
C   STOPCSM ; Convergence criteria for soil moisture difference; [L]
C   STOPCSP ; Fraction of water demand to be used as convergence criteria for
C              iterative supply adjustment
C-------------------------------------------------------------------------------
C   VALUE                       DESCRIPTION
C-------------------------------------------------------------------------------
     2                          / MSOLVE
     1.0                        / RELAX
     1500                       / MXITER
     150                        / MXITERSM
     50                         / MXITERSP
     0.0001                     / STOPC
     0.001                      / STOPCSM
     0.001                      / STOPCSP
C*******************************************************************************
C                    Water Budget Control Options
C
C   KOPTDM;  Enter  0 or 1 as follows;
C            0 = Agricultural water supply requirement is read in from file Unit 19;
C            1 = Agricultural demand is computed based on CUAW (i.e. AG. DEMAND=CUAW/I.E.)
C                In this case file unit 22 must be provided.
C   KOPTDV;  Enter two digits as follows:
C            1st digit(from left):
C                       0 = No adjustment for groundwater pumping
C                       1 = YES: Adjust groundwater pumping
C
C            2nd digit(from left):
C                       0 = No adjustment for streamflow diversion
C                       1 = YES: Surface Water Div. = Total Demand-Groundwater Pumping
C                       2 = YES: Surface Water Div. = Total Demand
C            ** Note: When this flag is set to a value other than 00, file Unit=12 is required.
C   NCROP;   Number of agricultural crops
C-------------------------------------------------------------------------------
C   VALUE                       DESCRIPTION
C-------------------------------------------------------------------------------
      1                        / KOPTDM
      01                       / KOPTDV
      2                        / NCROP
```

Parameter File Unit 7

The parameter data file contains multiple data types that include parameters for all groundwater nodes and layers. Data may be by parametric grids, or node-by-node parametric values. Parameters are also set for the unsaturated zone, soil moisture, small stream watersheds, streambeds, lakes, and water use. The file is broken into the following sections:

Aquifer Parameters

Aquifer parameters can be specified using parametric grids (NGROUP>0) or for each groundwater node (NGROUP=0). The NGROUP value indicates the number of parametric grids used to define aquifer parameters. Regardless of the value specified for NGROUP, the following list specifies the variables that must be defined in Unit 7:

NGROUP	Number of parametric grid groups
FX	Conversion factor for parametric grid coordinates
FKH	Conversion factor for the spatial component for the unit of aquifer horizontal hydraulic conductivity
FS	Conversion factor for specific storage coefficient
FN	Factor to weight specific yield value
FV	Conversion factor for the spatial component for the unit of aquitard vertical hydraulic conductivity
FL	Conversion factor for the spatial component for the unit of aquifer vertical hydraulic conductivity

FSCE	Conversion factor for elastic storage coefficient
FSCI	Conversion factor for inelastic storage coefficient
FDC	Conversion factor for interbed thickness
FDCMIN	Conversion factor for minimum interbed thickness
FHC	Conversion factor for pre-compaction hydraulic head
TUNITKH	Time unit of horizontal hydraulic conductivity. This should be one of the units recognized by HEC-DSS that are listed in the Main Control File.
TUNITV	Time unit of aquitard vertical conductivity. This should be one of the units recognized by HEC-DSS that are listed in the Main Control File.
TUNITL	Time unit of aquifer vertical conductivity. This should be one of the units recognized by HEC-DSS that are listed in the Main Control File.

From the parametric grid information, aquifer parameters at parametric nodes are interpolated to obtain parameter values at finite element nodes within the model domain. A parametric grid group may zoom in closer on groundwater nodes associated with the group and overwrite values given in the previous group. A value of –1 for any parameter specified for a node within a parametric grid group indicates that the parameter value specified in the previous group for the parametric node remains the same value. For NGROUP value greater than zero, the following information must be defined for each parametric grid group:

NDP	Number of parametric nodes in the parametric grid

NEP	Number of parametric elements in the parametric grid
IE	Parametric element number
NODE	Corresponding parametric node
ID	Parametric node number
PX, PY	Parametric node coordinates, [L]
PKH	Aquifer horizontal hydraulic conductivity, [L/T]
PS	Specific storage, [1/L]
PN	Specific yield, [L/L]
PV	Aquitard vertical hydraulic conductivity, [L/T]
PL	Aquifer vertical hydraulic conductivity, [L/T]
SCE	Elastic storage coefficient (Use SCE*DC if DC=0), [1/L]
SCI	Inelastic storage coefficient (Use SCI*DC if DC=0), [1/L]
DC	Interbed thickness, [L]
DCMIN	Minimum interbed thickness, [L]
HC	Pre-compaction hydraulic head (set to 99999.0 to use the initial heads for the value of HC), [L]

The values of SCE, SCI, DC, DCMIN and HC are specified only for interbed layers.

In order to set parameters at specified finite element nodes to values defined at an individual parametric node, then the number of parametric nodes, NDP, should be given as 1 and number of parametric elements, NEP, should be given as 0. This is useful when a portion or the entire model domain is homogeneous, and parameters at specified finite element nodes are required to be set to the same values. If this feature is utilized (i.e.

NDP is set to 1 and NEP is set to 0) then the construction of parametric elements needs to be skipped (i.e. specification of IE and NODE).

If no parametric grids are specified, advance to the point in the data file where aquifer parameters are specified by each groundwater node (Option 2). In this case, the above parameter values are specified for each finite element node. The conversion factors specified above are used to convert input data units to the units that are used in the simulation.

Anomaly in Hydraulic Conductivity

If there are hydraulic conductivity values defined in the previous section that need to be overwritten, the following parameters in this file must be defined:

NEBK	Number of elements where hydraulic conductivity values will be overwritten
FACT	Conversion factor for the spatial component for the unit of anomaly hydraulic conductivity values
TUNITH	Time unit of anomaly hydraulic conductivity. This should be one of the units recognized by HEC-DSS that are listed in the Main Control File.
IC	Identification number of the element for which anomaly hydraulic conductivity is defined
IEBK	Element number corresponding to counter IC
BK	Hydraulic conductivity at the specified element; this value should be given for each aquifer layer modeled in IWFM

Unsaturated Zone Parameters

This section is skipped if soil moisture in the unsaturated zone is not modeled, i.e. no rain gages are specified in the Pre-processor. Similar to aquifer parameters, the unsaturated zone parameters can be defined for each element, or by parametric grids. Regardless of how unsaturated zone parameters are defined, the number of layers, parametric groups and conversion factors must be specified:

NUNSAT	Number of layers in the unsaturated zone
NGROUP	Number of parametric groups that define the unsaturated zone parameters
FX	Conversion factor for parametric grid coordinates (it should be specified even if parametric grids are not being used and unsaturated zone parameters are specified for each element)
FD	Conversion factor for the thickness of the unsaturated layer
FN	Factor to weight unsaturated zone porosity
FL	Conversion factor for the spatial component of the unit of unsaturated zone hydraulic conductivity
TUNITZ	Time unit of hydraulic conductivity. This should be one of the unitsrecognized by HEC-DSS that are listed in the Main Control File.

If the option to use parametric grids is selected (Option 1), the following procedure occurs: the grid must first be defined by number of nodes and elements, then the makeup of the elements by nodes, and finally the specific characteristics of those nodes with respect to the unsaturated zone parameters:

NDP	Number of nodes in the parametric grid
NEP	Number of elements in the parametric grid
IE	Parametric element number
NODE	Corresponding parametric nodes (4 nodes should entered for each parametric element. For triangular elements 4^{th} node must be set to zero)
ID	Parametric node number
PX	x-coordinate of the parametric node, [L]
PY	y-coordinate of the parametric node, [L]
PD	Thickness of unsaturated layer (if thickness for the last unsaturated layer is entered as zero, the program will compute the thickness of the last unsaturated layer), [L]
PN	Effective porosity of unsaturated zone, [L/L]
PL	Hydraulic conductivity of unsaturated zone, [L/T]

If no parametric grids are specified, advance to the point in the data file where unsaturated zone parameters are specified by each element (Option 2). In this case, the above parameter values are specified for each finite element. The conversion factors specified above are used to convert input data units to the units that are used in the simulation.

Parameters for Soil Moisture Routing

This section is skipped if the root zone is not modeled, i.e. if no rain gages are specified in the Pre-processor. The following root zone parameters are specified by subregion for the four soil types and land use types modeled:

KUSAGE	Enter 0 (zero) if values listed for K are the fraction of excess soil moisture that will become deep percolation; enter 1 if values listed for K are saturated hydraulic conductivity of soil
FACT	Conversion factor for the spatial component for the unit of root zone hydraulic conductivity
TUNITS	Time unit of hydraulic conductivity. This should be one of the units recognized by HEC-DSS that are listed in the Main Control File. If KUSAGE is set to 0 (zero), this variable should still be set even though it will not be used by IWFM.
IREGN	Subregion number
FC	Field capacity (it is converted to a unit of depth in IWFM by multiplying it with the root zone depth), [L/L]
EF	Total porosity as a fraction of root zone depth (it is converted to a unit of depth in IWFM by multiplying it with the root zone depth), [L/L]
K	Hydraulic conductivity of the root zone, [L/T]
CN	Curve Number with respect to soil type and land use type

Small Stream Watershed Groups

If no rain gages are specified in the Pre-processor, then this section should be skipped. The small stream watershed data specified in this file is related to each small stream watershed group defined. Each group can correspond to several small stream watersheds that have the same characteristics. In the boundary conditions data file, individual small stream watersheds are specified with respect to the groundwater nodes they are connected to and the small stream watershed group they correspond to. The values listed below are necessary to define the impacts of small watersheds at the model boundary:

NSW	Number of small watershed groups
FACTL	Conversion factor for small stream watershed root zone depth and groundwater threshold value
FACTK	Conversion factor for the spatial component of the unit for the small stream watershed hydraulic conductivity
TUNITK	Time unit of hydraulic conductivity. This should be one of the units recognized by HEC-DSS that are listed in the Main Control File.
FACTT	Conversion factor for recession coefficients
TUNITT	Time unit of recession coefficients. This should be one of the units recognized by HEC-DSS that are listed in the Main Control File.
IS	Small watershed group identification number
IRNS	Rainfall station number associated with the small watershed
FRNS	Rainfall weighting factor for the small watershed
FLDCAS	Field capacity (multiplied by the root zone depth in IWFM to be converted to a unit of depth), [L/L]
TPOROS	Total porosity (multiplied by the root zone depth in IWFM to be converted to a unit of depth), [L/L]

CROOT Root zone depth of native vegetation in the small watershed, [L]

SOILKS Hydraulic conductivity of the root zone, [L/T]

CN Curve number for small watershed area

GWSOS Threshold value above which groundwater storage of small watershed contributes to surface runoff, [L]

SWKS Recession coefficient for surface outflow, [1/T]

GWKS Recession coefficient for base flow, [1/T]

Stream Bed Parameters

Values of hydraulic conductivity, thickness of streambed and the wetted perimeter are listed for each stream node in the system. Stream node numbers were input in the pre-processor stream specification input data file. Space is available at the end of each row to declare the stream name, this is optional. The list of stream bed parameters defined in this file is as follows:

FACTK Conversion factor for the spatial component of the unit for the stream bed conductivity

TUNITSK Time unit of conductivity. This should be one of the units recognized by HEC-DSS that are listed in the Main Control File.

FACTL Conversion factor for stream bed thickness and wetted perimeter

IR Stream node number

CSTRM Hydraulic conductivity of stream bed, [L/T]

DSTRM Thickness of stream bed, [L]

WETPR Wetter perimeter, [L]

Lake Parameters

Lake parameters for each lake modeled are defined in this file. The variables must be defined for each lake modeled in IWFM and are listed as follows:

FACTK	Conversion factor for the spatial component of the unit for lake bed conductivity
TUNITLK	Time unit of hydraulic conductivity. This should be one of the units recognized by HEC-DSS that are listed in the Main Control File.
FACTL	Conversion factor for the thickness of lake bed
IL	Lake identification number
CLAKE	Hydraulic conductivity of the lake bed, [L/T]
DLAKE	Thickness of the lake bed, [L]
ICHLMAX	Column number in file unit 28 for maximum lake elevation

Water Use Parameters

If no land surface processes are modeled, i.e. no rain gages are specified in Pre-processor, the values defined below should not be specified. The water use parameters are defined by subregion and include the amount of pervious urban area, the re-use factors for the agricultural and urban return flow, and how the urban return flow is routed. Directly below the subregional water use parameter specification, the root zone depth is defined for each crop type modeled in IWFM:

IR	Subregion number
PERV	Fraction of pervious urban area to total urban area

ICRUFAG	Fraction of the surface runoff from agricultural applied water that is re-used (this number corresponds to the data column in irrigation water re-use factor data file, Unit 29)
ICRUFURB	Fraction of the surface runoff and return flow from urban areas that is re-used (this number corresponds to the data column in irrigation water re-use factor data file, Unit 29)
IURIND	Urban return flow specification. Return flow can leave the model boundary (-2), become groundwater recharge (-1), enter streams at the stream node that the element over which urban area lies is associated with (0); or more specifically, enter streams at a stream node, nd.
FACT	Conversion factor for crop root zone depths
IC	Crop type number
ROOT	Crop root zone depth, [L]

```
C*******************************************************************************
C
C                  INTEGRATED WATER FLOW MODEL (IWFM)
C                         *** Version ### ***
C
C*******************************************************************************
C
C                            PARAMETER DATA FILE
C                            for IWFM Simulation
C                                  (Unit 7)
C
C
C             Project :  IWFM Version ### Release
C                        California Department of Water Resources
C             Filename:  PARAMETER.DAT
C
C*******************************************************************************
C                             File Description:
C
C   This data file contains the aquifer parameters for each groundwater node
C   and each layer. The parameters may be set by using a parametric
C   grid to interpolate values or by listing values for each node
C   individually. In addition, this file contains the parameters for the
C   unsaturated zone, lakes, and stream beds along with field capacity and
C   wilting point for each soil type.
C
C*******************************************************************************
C                           AQUIFER PARAMETERS
C
C-------------------------------------------------------------------------------
C   Option 1 - Set aquifer parameters by use of a parametric grid(NGROUP > 0)
C   Option 2 - Set aquifer parameters at every groundwater node  (NGROUP = 0)
C
C   NGROUP;  Number of parametric grid groups
C
C-------------------------------------------------------------------------------
C       VALUE                   DESCRIPTION
C-------------------------------------------------------------------------------
         6                      / NGROUP
C------------------------------------------------------------------------------
C   OPTIONS 1 & 2 : The following lists the factors to convert the aquifer
C   parameters and grid coordinates to the appropriate units
C
C   FX     ;  Conversion factor for parametric grid coordinates
C   FKH    ;  Conversion factor for horizontal hydraulic conductivity
C              It is used to convert only the spatial component of the unit;
C              DO NOT include the conversion factor for time component of the unit.
C              * e.g. Unit of hydraulic conductivity listed in this file = FT/MONTH
C                     Consistent unit used in simulation                = IN/DAY
C                     Enter FKH (FT/MONTH -> IN/MONTH)                  = 8.33333E-02
C                      (conversion of MONTH -> DAY is performed automatically)
C   FS     ;  Conversion factor for specific storage coefficient
C   FN     ;  Weighting factor for specific yield value
C   FV     ;  Conversion factor for aquitard vertical hydraulic conductivity
C              It is used to convert only the spatial component of the unit;
C              DO NOT include the conversion factor for time component of the unit.
C              * e.g. Unit of hydraulic conductivity listed in this file  = FT/MONTH
C                     Consistent unit used in simulation                = IN/DAY
C                     Enter FV (FT/MONTH -> IN/MONTH)                   = 8.33333E-02
C                      (conversion of MONTH -> DAY is performed automatically)
C   FL     ;  Conversion factor for aquifer vertical hydraulic conductivity
C              It is used to convert only the spatial component of the unit;
C              DO NOT include the conversion factor for time component of the unit.
C              * e.g. Unit of hydraulic conductivity listed in this file = FT/MONTH
C                     Consistent unit used in simulation                = IN/DAY
C                     Enter FL (FT/MONTH -> IN/MONTH)                   = 8.33333E-02
C                      (conversion of MONTH -> DAY is performed automatically)
C   FSCE   ;  Conversion factor for elastic storage coefficient
C   FSCI   ;  Conversion factor for inelastic storage coefficient
C   FDC    ;  Conversion factor for interbed thickness
C   FDCMIN ;  Conversion factor for minimum interbed thickness
C   FHC    ;  Conversion factor for pre-compaction hydraulic head
C   TUNITKH;  Time unit of horizontal hydraulic conductivity.  This should be one of the units
C              recognized by HEC-DSS that are listed in the Main Control File.
C   TUNITV ;  Time unit of aquitard vertical conductivity.  This should be one of the units
C              recognized by HEC-DSS that are listed in the Main Control File.
C   TUNITL ;  Time unit of aquifer vertical conductivity.  This should be one of the units
C              recognized by HEC-DSS that are listed in the Main Control File.
C
C-----------------------------------------------------------------------------------------------------------------------
C  FX      FKH        FS         FN        FV        FL       FSCE       FSCI       FDC       FDCMIN      FHC
C-------------------------------------------------------------------------------------------------------------------------
  3.281    1.0     0.000001      1.0       1.0       1.0     0.000001    0.002      1.0        1.0        1.0
C-----------------------------------------------------------------------------------------------------------------------
C   VALUE              DESCRIPTION
C-----------------------------------------------------------------------------------------------------------------------
    1MON               / TUNITKH
    1MON               / TUNITV
    1MON               / TUNITL
C*******************************************************************************
```

```
C                  OPTION 1 (for Aquifer Parameter Definition)
C********************************************************************************
C--------------------------------------------------------------------------------
C   *** GROUP 1 ***
C--------------------------------------------------------------------------------
C   Enter node numbers from the FE grid for the 1st parametric group
C     (e.g. 1-100,101,301-359,567)
C--------------------------------------------------------------------------------
     1-1393
C--------------------------------------------------------------------------------
C
C   NDP;     Number of nodes in the 1st parametric grid
C   NEP;     Number of elements in the 1st parametric grid
C
C--------------------------------------------------------------------------------
C   VALUE                       DESCRIPTION
C--------------------------------------------------------------------------------
     33                         / NDP
     20                         / NEP
C--------------------------------------------------------------------------------
C
C   The following is a list of the parametric elements and
C   corresponding parametric nodes for the 1st parametric group
C   (to be used only when parametric option is used, ie. NDP > 0)
C
C   IE  ;    Parametric element number
C   NODE;    Corresponding parametric node
C
C--------------------------------------------------------------------------------
C            Node 1    Node 2    Node 3     Node 4
C    IE       NODE      NODE      NODE       NODE
C-------------------------------------------------------------------------------
      1         1         3         4          2
      2         3         5         6          4
      .         .         .         .          .
      .         .         .         .          .
      .         .         .         .          .
     19        28        31        32         29
     20        29        32        33         30
C--------------------------------------------------------------------------------
C
C   List the paramatric nodes, nodal coordinates and aquifer
C   parameters for each layer of the 1st parametric group
C   (enter -1.0 not to overwrite the previously set values)
C
C   ID   ;   Parametric node number
C   PX,PY;   Parametric node coordinates; [L]
C   PKH  ;   Hydraulic conductivity; [L/T]
C   PS   ;   Specific storage; [1/L]
C   PN   ;   Specific yield; [L/L]
C   PV   ;   Aquitard vertical hydraulic conductivity; [L/T]
C   PL   ;   Aquifer vertical hydraulic conductivity; [L/T]
C   SCE  ;   Elastic storage coefficient (Use SCE*DC if DC=0); [1/L]
C   SCI  ;   Inelastic storage coefficient (Use SCI*DC if DC=0); [1/L]
C   DC   ;   Interbed thickness;[L]
C   DCMIN;   Minimum interbed thickness; [L]
C   HC   ;   Pre-compaction hydraulic head (use 99999. to use initial heads); [L]
C            *Note* The above land subsidence parameters are only for interbed layers (i.e. clay layers)
C---------------------------------------------------------------------------------------------------------------------
C  ID         PX         PY         PKH      PS       PN    PV       PL       SCE     SCI      DC        DCMIN   HC
C---------------------------------------------------------------------------------------------------------------------
    1      526411   4488044     100.00     1.0      0.08  0.20     1.0      4.5   0.050     -1        2      99999.
                                 60.00     5.0      0.05  1.00     1.0      4.5   0.050     -1        2      99999.
                                 60.00     5.0      0.05  0.60     0.6      4.5   0.050     -1        2      99999.
    2      576022   4510977      80.00     1.0      0.09  0.20     1.0      4.5   0.050     -1        2      99999.
                                 40.00     5.0      0.05  1.00     1.0      4.5   0.050     -1        2      99999.
                                 40.00     5.0      0.05  0.60     0.6      4.5   0.050     -1        2      99999.
    .         .         .          .        .        .     .        .        .       .       .        .          .
                                   .        .        .     .        .        .       .       .        .          .
                                   .        .        .     .        .        .       .       .        .          .
    .         .         .          .        .        .     .        .        .       .       .        .          .
                                   .        .        .     .        .        .       .       .        .          .
                                   .        .        .     .        .        .       .       .        .          .
   33      899721   3868499      80.00     1.0      0.12  0.20     1.0      4.5    1.00     -1        2      99999.
                                 50.00     2.0      0.07  0.0001   0.1      4.5    1.00     -1        3      99999.
                                 20.00     3.0      0.07  0.60     0.6      4.5    1.00     -1        3      99999.
C---------------------------------------------------------------------------------------------------------------------
C    *** GROUP 2 ***
C---------------------------------------------------------------------------------
C   Enter node numbers from the FE grid for the 2nd parametric group
C     (e.g. 1-100,101,301-359,567)
C---------------------------------------------------------------------------------
    1318-1321,1325,1329-1336,1339-1347,1349-1358,1360-1393
C--------------------------------------------------------------------------------
C
C   NDP;     Number of nodes in the 2nd parametric grid
C   NEP;     Number of elements in the 2nd parametric grid
C
C--------------------------------------------------------------------------------
C   VALUE                        DESCRIPTION
```

```
C-------------------------------------------------------------------------------
     6                           / NDP
     2                           / NEP
C-------------------------------------------------------------------------------
C   Element   Node 1    Node 2    Node 3     Node 4
C    IE        NODE      NODE      NODE       NODE
C-------------------------------------------------------------------------------
      1         34        37        38         35
      2         35        38        39         36
C------------------------------------------------------------------------------
C
C   List the paramatric nodes, nodal coordinates and aquifer
C   parameters for each layer of the 2nd parametric group
C   (enter -1.0 not to overwrite the previously set values)
C
C   ID   ;   Parametric node number
C   PX,PY;   Parametric node coordinates; [L]
C   PKH  ;   Hydraulic conductivity; [L/T]
C   PS   ;   Specific storage; [1/L]
C   PN   ;   Specific yield; [L/L]
C   PV   ;   Aquitard vertical hydraulic conductivity; [L/T]
C   PL   ;   Aquifer vertical hydraulic conductivity; [L/T]
C   SCE  ;   Elastic storage coefficient (Use SCE*DC if DC=0); [1/L]
C   SCI  ;   Inelastic storage coefficient (Use SCI*DC if DC=0); [1/L]
C   DC   ;   Interbed thickness;[L]
C   DCMIN;   Minimum interbed thickness; [L]
C   HC   ;   Pre-compaction hydraulic head (use 99999. to use initial heads); [L]
C            *Note* The above land subsidence parameters are only for interbed layers (i.e. clay layers)
C-----------------------------------------------------------------------------------------------------------------------
C  ID         PX         PY        PKH      PS       PN     PV       PL       SCE     SCI      DC       DCMIN    HC
C-----------------------------------------------------------------------------------------------------------------------
   34       795918   3906758     100.      1.     .12      .2      1.0       -1      -1       -1      -1        -1
                                  80.      5.     .07      .002     .5       -1      -1       -1      -1        -1
                                  20.      3.     .07      .6       .6       -1      -1       -1      -1        -1
    .          .         .         .       .       .       .        .        .       .        .       .         .
                                   .       .       .       .        .        .       .        .       .         .
                                   .       .       .       .        .        .       .        .       .         .
    .          .         .         .       .       .       .        .        .       .        .       .         .
                                   .       .       .       .        .        .       .        .       .         .
                                   .       .       .       .        .        .       .        .       .         .
   39       905818   3868499      80.      1.     .12      .2      1.0       -1      -1       -1      -1        -1
                                  50.     10.     .07      .0015     .4      -1      -1       -1      -1        -1
                                   5.      8.     .07      .6        .6      -1      -1       -1      -1        -1
C------------------------------------------------------------------------------------------------------------------------
C    *** GROUP 3 ***
C-------------------------------------------------------------------------------
   .          .
   .          .
   .          .
C--------------------------------------------------------------------------------------------
C    *** GROUP 6 ***
C-------------------------------------------------------------------------------
C   Enter node numbers from the FE grid for the 6th parametric group
C     (e.g. 1-100,101,301-359,567)
C-------------------------------------------------------------------------------
 792  791  790  789  788  787  786  785
 784  769  768
 757  756  755  754  753  752  751  750
 749  728
 741  740  739  738  737  736  729
 715  702
 701  700  699  698  697  696  695  694
 693  683
 681  682
 671  660  649
 657  656  655  654  653  652  651  650  633
 623  622  621  620  619  618  617  616
 615  605  592  576  567  558
C------------------------------------------------------------------------------
C
C   NDP;     Number of nodes in the 6th parametric grid
C   NEP;     Number of elements in the 6th parametric grid
C
C------------------------------------------------------------------------------
C   VALUE                       DESCRIPTION
C-------------------------------------------------------------------------------
     1                           / NDP
     0                           / NEP
C-------------------------------------------------------------------------------
C   Element   Node 1    Node 2    Node 3     Node 4
C    IE        NODE      NODE      NODE       NODE
C-------------------------------------------------------------------------------
*
*
C------------------------------------------------------------------------------
C
C   List the paramatric nodes, nodal coordinates and aquifer
C   parameters for each layer of the 6th parametric group
C
C   ID;      Parametric node number
```

```
C   PX,PY;   Parametric node coordinates [L]
C   PKH;     Hydraulic conductivity [L/T]
C   PS;      Specific storage [1/L]
C   PN;      Specific yield [FT/FT]
C   PV;      Aquitard vertical hydraulic conductivity [L/T]
C   PL;      Aquifer vertical hydraulic conductivity [L/T]
C   SCE;     Elastic storage coefficient (Use SCE*DC if DC=0) [1/L]
C   SCI;     Inelastic storage coefficient (Use SCI*DC if DC=0) [1/L]
C   DC;      Interbed thickness
C   DCMIN;   Minimum interbed thickness
C   HC;      Pre-compaction hydraulic head (use 99999. to use initial heads) [L]
C            *Note* The above land subsidence parameters are only for interbed layers (i.e. clay layers)
C-------------------------------------------------------------------------------------------------------------------
C  ID         PX       PY          PKH     PS       PN     PV       PL       SCE     SCI       DC     DCMIN      HC
C-------------------------------------------------------------------------------------------------------------------
   43     742369.0  3867036.0       40.    -1       -1     -1       -1       -1      -1        -1     -1         -1
                                    -1     -1       -1     -1       -1       -1      -1        -1     -1         -1
                                    -1     -1       -1     -1       -1       -1      -1        -1     -1         -1
C-------------------------------------------------------------------------------------------------------------------
C*******************************************************************************
C                  OPTION 2 (for Aquifer Parameter Definition)
C*******************************************************************************
C
C    List the groundwater nodes, and aquifer parameters for
C    each layer (skip if option 1 is used)
C
C   ID   ;   Groundwater node number
C   PKH  ;   Hydraulic conductivity; [L/T]
C   PS   ;   Specific storage; [1/L]
C   PN   ;   Specific yield; [L/L]
C   PV   ;   Aquitard vertical hydraulic conductivity; [L/T]
C   PL   ;   Aquifer vertical hydraulic conductivity; [L/T]
C   SCE  ;   Elastic storage coefficient (Use SCE*DC if DC=0); [1/L]
C   SCI  ;   Inelastic storage coefficient (Use SCI*DC if DC=0); [1/L]
C   DC   ;   Interbed thickness; [L]
C   DCMIN;   Minimum interbed thickness; [L]
C   HC   ;   Pre-compaction hydraulic head (use 99999. to use initial heads); [L]
C            *Note* The above land subsidence parameters are only for interbed layers (i.e. clay layers)
C
C--------------------------------------------------------------------------------
C                           Layer  1
C                           Layer  2
C                              .
C                              .
C
C        Hydr.   Spec.    Spec.  Aquitard  Aquifer   Elastic   Inelastic   Interbed   Min. Intrbd   Precompc
C        cond.   Stor.    Yld.    Vert. K  Vert. K  Stg. Coef. Stg. Coef.  Thickness   Thickness    Hyd. Head
C  ID      PKH     PS       PN       PV       PL       SCE        SCI         DC        DCMIN          HC
C---------------------------------------------------------------------------------------------------------------
*
C---------------------------------------------------------------------------------------------------------------
C*******************************************************************************
C                     ANOMALY IN HYDRAULIC CONDUCTIVITY
C
C   List the groundwater elements and corresponding aquifer
C   parameters for nodes that will overwrite the above aquifer data
C
C   NEBK;   Number of elements where hydraulic conductivity
C             values will be overwritten
C   FACT;   Conversion factor for the anomaly hydraulic conductivity
C            It is used to convert only the spatial component of the unit;
C            DO NOT include the conversion factor for time component of the unit.
C            * e.g. Unit of anomaly hydraulic conductivity listed in this file = FT/MONTH
C                   Consistent unit used in simulation                        = IN/DAY
C                   Enter FACT (FT/MONTH -> IN/MONTH)                         = 8.33333E-02
C                    (conversion of MONTH -> DAY is performed automatically)
C   TUNITH; Time unit of anomaly hydraulic conductivity.  This should be one of the units
C             recognized by HEC-DSS that are listed in the Main Control File.
C-------------------------------------------------------------------------------
C   VALUE                       DESCRIPTION
C-------------------------------------------------------------------------------
      7                       / NEBK
      1.0                     / FACT
      1MON                    / TUNITH
C--------------------------------------------------------------------------------
C
C   IC  ;    Counter for number of overwrite options
C   IEBK;    Element number corresponding to counter IC
C   BK  ;    Hydraulic conductivity at the specified node; [L/T]
C-----------------------------------------------------------------------------
C                           LAYER 1   LAYER 2   LAYER 3
C     IC          IEBK        BK        BK       BK
C-------------------------------------------------------------------------------
       1           55        .2        .2       .2
       2           56        .2        .2       .2
       3           57        .2        .2       .2
       4           58        .2        .2       .2
       5         1383        .001      .001     .001
       6         1384        .001      .001     .001
       7         1385        .001      .001     .001
```

```
C*******************************************************************************
C                        UNSATURATED ZONE PARAMETERS
C            (Skip if no rain gages are specified in the pre-processor)
C
C   NUNSAT;  Number of layers in the unsaturated zone
C-------------------------------------------------------------------------------
C   VALUE                          DESCRIPTION
C-------------------------------------------------------------------------------
     2                             / NUNSAT
C-------------------------------------------------------------------------------
C   Option 1 - Set unsaturated zone parameters by use of a parametric grid(NGROUP > 0)
C   Option 2 - Set unsaturated zone parameters at every groundwater node  (NGROUP = 0)
C
C   NGROUP;  Number of parametric grid groups
C-------------------------------------------------------------------------------
C   VALUE                          DESCRIPTION
C-------------------------------------------------------------------------------
     0                             / NGROUP
C------------------------------------------------------------------------------
C   OPTIONS 1 & 2 : The following lists the factors to convert the unsaturated
C                   zone parameters and grid coordinates to the appropriate units
C
C
C   FX;      Conversion factor for grid coordinates
C   FD;      Conversion factor for the thickness of the unsaturated layer
C   FN;      Weighting factor for unsaturated zone porosity
C   FL;      Conversion factor for hydraulic conductivity
C              It is used to convert only the spatial component of the unit;
C              DO NOT include the conversion factor for time component of the unit.
C              * e.g. Unit of hydraulic conductivity listed in this file = FT/MONTH
C                     Consistent unit used in simulation                 = IN/DAY
C                     Enter FACT (FT/MONTH -> IN/MONTH)                  = 8.33333E-02
C                      (conversion of MONTH -> DAY is performed automatically)
C   TUNITZ;  Time unit of hydraulic conductivity.  This should be one of the units
C              recognized by HEC-DSS that are listed in the Main Control File.
C
C-------------------------------------------------------------------------------
C    FX             FD             FN             FL
C-------------------------------------------------------------------------------
     1.0            1.0            1.0           1.0
C-------------------------------------------------------------------------------
C   VALUE                          DESCRIPTION
C-------------------------------------------------------------------------------
     1mon                          / TUNITZ
C*******************************************************************************
C            OPTION 1 (for Unsaturated Zone Parameter Definition)
C*******************************************************************************
C-------------------------------------------------------------------------------
C   *** GROUP 1 ***
C-------------------------------------------------------------------------------
C   Enter element numbers from FE grid for the 1st parametric group
C     (e.g. 1-100,101,301-359,567)
C-------------------------------------------------------------------------------
*
C-------------------------------------------------------------------------------
C
C   NDP;     Number of nodes in the 1st parametric grid
C   NEP;     Number of elements in the 1st parametric grid
C
C-------------------------------------------------------------------------------
C   VALUE                          DESCRIPTION
C-------------------------------------------------------------------------------
*                                   / NDP
*                                   / NEP
C-------------------------------------------------------------------------------
C
C   The following is a list of the parametric elements and
C   corresponding parametric nodes for the 1st parametric group
C   (to be used only when parametric option is used, ie. NDP > 0)
C
C   IE  ;    Parametric element number
C   NODE;    Corresponding parametric node
C
C-------------------------------------------------------------------------------
C             Node 1    Node 2    Node 3     Node 4
C    IE        NODE      NODE      NODE       NODE
C------------------------------------------------------------------------------
*
C-------------------------------------------------------------------------------
C    List the parametric nodes,coordinates, and unsaturated zone parameters for
C    each layer of the 1st parametric group (skip if option 2 is used)
C
C   ID;      Parametric node number
C   PX;      x-coordinate of the parametric node; [L]
C   PY;      y-coordinate of the parametric node; [L]
C   PD;      Thickness of unsaturated layer; [L]
C   PN;      Effective porosity; [L/L]
C   PL;      Hydraulic conductivity; [L/T]
C-------------------------------------------------------------------------------
C          NODAL COORDINATES     Thickness     Porosity    Hyd. Cond.
```

```
C   ID       PX      PY              PD           PN           PL
C-------------------------------------------------------------------------------
*
C-------------------------------------------------------------------------------------
C    *** GROUP 2 ***
C--------------------------------------------------------------------------------
C   Enter element numbers from FE grid for the 2nd parametric group
C     (e.g. 1-100,101,301-359,567)
C--------------------------------------------------------------------------------
*
C-------------------------------------------------------------------------------
C
C   NDP;     Number of nodes in the 2nd parametric grid
C   NEP;     Number of elements in the 2nd parametric grid
C
C-------------------------------------------------------------------------------
C   VALUE                       DESCRIPTION
C--------------------------------------------------------------------------------
*                                / NDP
*                                / NEP
C--------------------------------------------------------------------------------
C   Element   Node 1    Node 2    Node 3     Node 4
C    IE        NODE      NODE      NODE       NODE
C--------------------------------------------------------------------------------
*
C-------------------------------------------------------------------------------
C    List the parametric nodes,coordinates, and unsaturated zone parameters for
C    each layer of the 2nd parametric group (skip if option 2 is used)
C
C   ID;      Parametric node number
C   PX;      x-coordinate of the parametric node; [L]
C   PY;      y-coordinate of the parametric node; [L]
C   PD;      Thickness of unsaturated layer; [L]
C   PN;      Effective porosity; [L/L]
C   PL;      Hydraulic conductivity; [L/T]
C-------------------------------------------------------------------------------
C          NODAL COORDINATES     Thickness     Porosity    Hyd. Cond.
C   ID       PX      PY              PD           PN           PL
C-------------------------------------------------------------------------------
*
C-------------------------------------------------------------------------------
C*******************************************************************************
C            OPTION 2 (for Unsaturated Zone Parameter Definition)
C*******************************************************************************
C
C   List the groundwater elements and unsaturated zone parameters for
C   each layer (skip if option 1 is used)
C
C   IE;      Element number
C   PD;      Thickness of unsaturated layer; [L]
C   PN;      Total porosity; [L/L]
C   PK;      Hydraulic conductivity; [L/T]
C-------------------------------------------------------------------------------
C                         LAYER 1                              LAYER 2
C       IE           PD         PN       PL              PD        PN        PL
C-------------------------------------------------------------------------------
         1        49.900      .120     1.000            0.000   .120     1.000
         2        49.900      .120     1.000            0.000   .120     1.000
         .             .         .         .                .      .         .
         .             .         .         .                .      .         .
         .             .         .         .                .      .         .
      1391        49.900      .120     1.000            0.000   .120     1.000
      1392        49.900      .120     1.000            0.000   .120     1.000
C-------------------------------------------------------------------------------
C*******************************************************************************
C                  PARAMETERS FOR SOIL MOISTURE ROUTING
C
C   The following lists the soil moisture and hydrologic properties for each
C   hydrologic soil group  (A,B,C,D) by subregion .
C    *Note* This portion of the parameter input should be skipped if no
C           rain gages are specified in file unit 13 during pre-processing
C-------------------------------------------------------------------------------------
C
C   KUSAGE; Flag that specifies how the value entered for variable K will be
C            interpreted.  Enter
C              0 : Values listed for K are the fraction of excess soil moisture
C                   that will become deep percolation
C              1 : Values listed for K are saturated hydraulic conductivity of soil
C   FACT;   Conversion factor for root zone hydraulic conductivity
C             It is used to convert only the spatial component of the unit;
C             DO NOT include the conversion factor for time component of the unit.
C             * e.g. Unit of hydraulic conductivity listed in this file = FT/MONTH
C                    Consistent unit used in simulation                = IN/DAY
C                    Enter FACT (FT/MONTH -> IN/MONTH)                 = 8.33333E-02
C                     (conversion of MONTH -> DAY is performed automatically)
C   TUNITS; Time unit of hydraulic conductivity.  This should be one of the units
C             recognized by HEC-DSS that are listed in the Main Control File.
C             * Note: If KUSAGE = 0, enter anything
C
C--------------------------------------------------------------------------------
```

```
C   VALUE                        DESCRIPTION
C-------------------------------------------------------------------------------
    1                            / KUSAGE
    1.0                          / FACT
    1mon                         / TUNITS
C-------------------------------------------------------------------------------
C
C   IREGN;      Subregion number
C   FC   ;      Field capacity; [L/L]
C   EF   ;      Total porosity; [L/L]
C   K    ;      Hydraulic conductivity of the root zone; [L/T]
C   CN   ;      Curve number depending on the land use type:
C                1-Agricultural ; 2-Urban ; 3-Native veg. ; 4-Riparian veg.
C               (Reference: USDA, 1985)
C
C-----------------------------------------------------------------------------------------------------------------------
C        SOIL GROUP A                  SOIL GROUP B                  SOIL GROUP C                    SOIL GROUP D
C IREGN -----------------------   ---------------------------   ---------------------------   ---------------------------
C                 CN BY LAND                     CN BY LAND                     CN BY LAND                     CN BY LAND
C     FC  EF  K  --------------    FC  EF  K  ---------------    FC  EF  K  ---------------    FC  EF  K  --------------
C                  1   2   3   4                1   2   3   4                1   2   3   4                   1   2  3  4
C-----------------------------------------------------------------------------------------------------------------------
  1  .06 .20 0.2  68  73  70  65  .08 .20 0.1  74  78  75  65   .10 .25 0.05  87 90  84  75  .10 .30 0.02   92  95 90 80
  2  .06 .20 0.5  68  73  70  65  .08 .20 0.2  74  78  75  65   .10 .25 0.1   87 90  84  75  .10 .30 0.05   92  95 90 80
  .   .   .   .   .   .   .   .    .   .   .   .   .   .   .     .   .   .     .  .   .   .    .   .   .     .   .  .  .
  .   .   .   .   .   .   .   .    .   .   .   .   .   .   .     .   .   .     .  .   .   .    .   .   .     .   .  .  .
  .   .   .   .   .   .   .   .    .   .   .   .   .   .   .     .   .   .     .  .   .   .    .   .   .     .   .  .  .
 20  .06 .20 0.1  68  73  70  65  .08 .20 0.05 74  78  75  65   .10 .25 0.01  87 90  84  75  .10 .30 0.005  92  95 90 80
 21  .06 .20 0.2  68  73  70  65  .08 .20 0.1  74  78  75  65   .10 .25 0.05  87 90  84  75  .10 .30 0.005  92  95 90 80
C*******************************************************************************
C                         SMALL STREAM WATERSHED DATA
C
C   The following  lists the small watershed parameters that are used in the
C   computation of runoff from the tributary watersheds outside the model boundary.
C
C *Note* This portion of the parameter input should be skipped if no rain gages
C        are specified in file unit 13 during pre-processing
C
C
C   NSW   ;   Number of small watershed groups
C   FACTL ;   Conversion factor for root zone depth and groundwater threshold value
C   FACTK ;   Conversion factor for hydraulic conductivity
C              It is used to convert only the spatial component of the unit;
C              DO NOT include the conversion factor for time component of the unit.
C              * e.g. Unit of hydraulic conductivity listed in this file = FT/MONTH
C                     Consistent unit used in simulation                = IN/DAY
C                     Enter FACT (FT/MONTH -> IN/MONTH)                 = 8.33333E-02
C                      (conversion of MONTH -> DAY is performed automatically)
C   TUNITK;   Time unit of hydraulic conductivity.  This should be one of the units
C              recognized by HEC-DSS that are listed in the Main Control File.
C   FACTT ;   Conversion factor for recession coefficients
C   TUNITT;   Time unit of recession coefficients.  This should be one of the units
C              recognized by HEC-DSS that are listed in the Main Control File.
C   IS    ;   Small watershed group identification number
C   IRNS  ;   Rainfall station number associated with the small watershed
C   FRNS  ;   Rainfall weighting factor for the small watershed
C   FLDCAS;   Field capacity; [L/L]
C   TPOROS;   Total porosity; [L/L]
C   CROOT ;   Root zone depth of native vegetation in the small watershed; [L]
C   SOILKS;   Hydraulic conductivity of the root zone; [L/T]
C   CN    ;   Curve number for small watershed area
C             (Reference: USDA, 1985)
C   GWSOS ;   Threshold value of groundwater depth above which groundwater
C                storage of small watershed contributes to surface runoff; [L]
C   SWKS  ;   Recession coefficient for surface outflow; [1/T]
C   GWKS  ;   Recession coefficient for base flow; [1/T]
C
C---------------------------------------------------------------------------
C   VALUE                 DESCRIPTION
C---------------------------------------------------------------------------
     15                   / NSW
     1.0                  / FACTL
     1.0                  / FACTK
     1mon                 / TUNITK
     1.0                  / FACTT
     1mon                 / TUNITT
C-----------------------------------------------------------------------------
C IS    IRNS    FRNS  FLDCAS TPOROS CROOT  SOILKS   CN   GWSOS    SWKS  GWKS
C-----------------------------------------------------------------------------
  1     29     3.00   .08   .10       3    1.00    80    10.      0.4  0.002
  .      .       .     .     .        .      .      .     .        .      .
  .      .       .     .     .        .      .      .     .        .      .
  .      .       .     .     .        .      .      .     .        .      .
  15    32     3.50   .08   .08       3    1.00    80    10.      0.4  0.002
C*******************************************************************************
C                        STREAM BED PARAMETERS
C
C     The following lists the parameters to model streams.
C     *Note* Skip data input if no streams are modeled
C
```

```
C   FACTK ;   Conversion factor for stream bed conductivity
C              It is used to convert only the spatial component of the unit;
C              DO NOT include the conversion factor for time component of the unit.
C              * e.g. Unit of conductivity listed in this file = FT/MONTH
C                     Consistent unit used in simulation       = IN/DAY
C                     Enter FACTK (FT/MONTH -> IN/MONTH)       = 8.33333E-02
C                      (conversion of MONTH -> DAY is performed automatically)
C   TUNITSK;  Time unit of conductivity.  This should be one of the units
C              recognized by HEC-DSS that are listed in the Main Control File.
C   FACTL ;   Conversion factor for stream bed thickness and wetted perimeter
C   IR    ;   Stream node number
C   CSTRM ;   Hydraulic conductivity of stream bed; [L/T]
C   DSTRM ;   Thickness of stream bed; [L]
C   WETPR ;   Wetted perimeter; [L]
C
C-------------------------------------------------------------------------------
C   VALUE                 DESCRIPTION
C-------------------------------------------------------------------------------
     1.0                  / FACTK
     1mon                 / TUNITSK
     1.0                  / FACTL
C--------------------------------------------------------------------------------
C    IR       CSTRM       DSTRM      WETPR        River Name (Optional)
C--------------------------------------------------------------------------------
      1        4.0        1.         200.0
      2        4.0        1.         200.0
      .          .        .              .
      .          .        .              .
      .          .        .              .
    430        0.0        1.         200.0
    431        0.0        1.         200.0
C********************************************************************************
C                           LAKE PARAMETERS
C
C     The parameters required to model lakes are listed below.
C     *Note* Skip data input if no lakes are modeled
C
C   FACTK ;   Conversion factor for lake bed hydraulic conductivity
C              It is used to convert only the spatial component of the unit;
C              DO NOT include the conversion factor for time component of the unit.
C              * e.g. Unit of hydraulic conductivity listed in this file = FT/MONTH
C                     Consistent unit used in simulation                 = IN/DAY
C                     Enter FACT (FT/MONTH -> IN/MONTH)                  = 8.33333E-02
C                      (conversion of MONTH -> DAY is performed automatically)
C   TUNITLK;  Time unit of hydraulic conductivity.  This should be one of the units
C              recognized by HEC-DSS that are listed in the Main Control File.
C   FACTL ;   Conversion factor for thickness of lake bed
C   IL    ;   Lake number
C   CLAKE ;   Hydraulic conductivity of the lake bed; [L/T]
C   DLAKE ;   Thickness of the lake bed; [L]
C   ICHLMAX;  Maximum lake elevation - this number corresponds to the data
C              column in the maximum lake elevations data file (Unit 28)
C
C--------------------------------------------------------------------------------
C   VALUE                 DESCRIPTION
C--------------------------------------------------------------------------------
     1.0                  / FACTK
     1mon                 / TUNITLK
     1.0                  / FACTL
C--------------------------------------------------------------------------------
C   IL       CLAKE      DLAKE      ICHLMAX     Lake Name (Optional)
C--------------------------------------------------------------------------------
     1        1.0      20.0          1
     2        1.0      20.0          2
C********************************************************************************
C                       WATER USE PARAMETERS
C
C   The following lists the water use parameters for each subregion and the
C   crop root zone depth for each crop type including urban (lawn) and
C   native vegetation (skip if soil moisture is not routed,
C   i.e. if there are no rain gages)
C
C   IR        ;  Subregion number
C   PERV      ;  Fraction of pervious area to total urban areas
C   ICRUFAG  ;  Fraction of the surface runoff from agricultural applied water
C                that is re-used - this number corresponds to the appropriate data
C                column in irrigation water re-use factor data file (Unit 29)
C   ICRUFURB ;  Fraction of the surface runoff and return flow from urban areas
C                that is re-used - this number corresponds to the appropriate data
C                column in irrigation water re-use factor data file (Unit 29)
C   IURIND   ;  Urban return flow specification
C                  -2;   Urban return flow goes out of model boundary
C                  -1;   Urban return flow goes into groundwater recharge
C                   0;   Urban return flow enters streams
C                  nd;   Urban return flow enters streams at stream node, nd
C
C--------------------------------------------------------------------------------
C   IR    PERV    ICRUFAG   ICRUFURB    IURIND
C--------------------------------------------------------------------------------
     1    .62        1        22         -1
```

```
     2    .62       2        22         -1
     .     .        .         .          .
     .     .        .         .          .
     .     .        .         .          .
    20    .62      20        22         -1
    21    .62      21        22          0
C--------------------------------------------------------------
C
C   FACT;    Conversion factor for crop root zone depths
C   IC  ;    Crop type number
C   ROOT;    Crop root zone depth; [L]
C
C--------------------------------------------------------------
C   VALUE                DESCRIPTION
C--------------------------------------------------------------
     1.0                 / FACT
C--------------------------------------------------------------
C   IC          ROOT
C--------------------------------------------------------------
     1           2.0
     2           6.0
     .             .
     .             .
     .             .
    16           3.0
    17           5.0
```

Boundary Conditions File Unit 8

The following types of boundary conditions can be input into the boundary data file for each aquifer layer modeled:

1. Specified flow
2. Specified head
3. Rating tables
4. General head

Small stream watersheds are also listed in this file. For each aquifer layer, boundary conditions 1-4 are specified, followed by the small stream watershed boundary conditions. The number of boundary condition nodes for a layer must be specified as zero for the conditions not used in the simulation.

Specified Flow

Specified flow boundary conditions are defined when the flow is known across surfaces bounding the domain. The number of nodes with a specified flow, the conversion factor, followed by the list of nodes and associated flow terms are required input for specified flow boundary conditions. The variables used to describe the input data are as follows:

NQB	Number of nodes with specified flow
FACT	Conversion factor for the spatial component of the unit for the specified flow data
TUNIT	Time unit of flow boundary conditions. This should be one of the units recognized by HEC-DSS that are listed in the Main Control File. If there are no specified flow boundary conditions (i.e. NQB = 0) then this variable can be left blank.

INODE	Groundwater node with a specified flow
BQ	Specified flow value at groundwater node INODE (if BQ is less than –10000, then –BQ–10000 indicates the column number in the time series boundary conditions data file), [L^3/T]

Specified Head

Specified head boundary conditions are input when the hydraulic head is known for surfaces bounding the domain. The number of boundary nodes with specified head values, conversion factor and each node and the related hydraulic head are defined in the input file in the following terms:

NHB	Number of groundwater nodes with specified head
FACT	Conversion factor for specified head
INODE	Groundwater node with a specified head
BH	Specified head value for node INODE (if less than –10000.0, then –BH–10000.0 indicates the column number corresponding to the time series boundary condition data), [L]

Rating Tables

Rating table boundary conditions are implemented when the rate of flow at the boundary can be determined as a function of the groundwater head. The number of nodes with a rating table condition, the number of points in each rating table, and the conversion factors for the head and flow rate are specified. This information is followed by each groundwater node with a rating table boundary condition and the corresponding head value and flow rate. The list of the description of variables for rating table boundary conditions is:

NMB	Number of nodes with a rating table boundary condition
NMTB	Number of points in the rating table
FACTH	Conversion factor for the head value
FACTQ	Conversion factor for the spatial component of the unit for the flow rate
TUNIT	Time unit of flow rate in the rating table. This should be one of the units recognized by HEC-DSS that are listed in the Main Control File. If there are no rating table type boundary conditions (i.e. NMB = 0) then this variable can be left blank.
INODE	Node number corresponding to a rating table boundary condition
HMTB	Head value, [L]
QMTB	Flow rate at the specified head HMTB, [L^3/T]

General Head

General head boundary conditions are defined when head values at a specified distances from boundary nodes are known. The number of general head boundary nodes is listed, followed by the conversion factors. This information is followed by the node numbers with a general head boundary condition and the related hydraulic head, area of influence and distance from each node. The following must be specified in this input to declare general head boundary conditions:

NGB	Number of groundwater nodes with general head boundary conditions
FACTH	Conversion factor for the head value
FACTAR	Conversion factor for area
INODE	Node number corresponding to the general head boundary condition
BH	Fixed head at distance BD from the groundwater node INODE (if less than –10000.0, then –BH–10000.0 indicates the column number in the time series boundary condition data), [L]
BA	Area of influence surrounding groundwater node INODE, [L^2]
BD	Distance from the groundwater node INODE to the source of the fixed head BH, [L]

Small Stream Watersheds

To account for flow from small stream watershed into the model domain, surface and subsurface flows leaving the small stream watershed and entering the model domain are simulated with an approximate method. The boundary condition values are implemented into the groundwater equation based on the computation of surface and subsurface flow using values defined in this file.

The surface runoff and groundwater recharge characteristics are specified for each small stream watershed modeled. Defined in this file is the number of small stream watersheds and related conversion factors. The following input includes each small watershed identification number and the related surface and subsurface information. The drainage area of the small watershed must be input, followed by the stream node within the model where surface runoff flows. The number of groundwater nodes that correspond to the small watershed is followed by a list that defines each groundwater identification number and the maximum recharge rate to that groundwater node during a single stress period. A value of −1 for the maximum recharge rate indicates that the subsurface flow will be directly contributed to groundwater nodes, whereas a positive value indicates the maximum amount of water that can percolate to the groundwater when routed from the small watershed to stream node IWBTS.

NTWB	Number of small watersheds where inflows will be computed and specified as boundary flow
FACTA	Conversion factor for small watershed drainage area
FACTQ	Conversion factor for the spatial component of the unit for the maximum recharge rate
TUNIT	Time unit of maximum recharge rate. This should be one of the units recognized by HEC-DSS that are listed in the Main Control File.
ID	Small watershed identification number
IWBS	Watershed group number corresponding to the numbers and parameters specified for watersheds in the parameter data file Unit 7
AREAS	Drainage area of the small watershed, $[L^2]$
IWBTS	Stream node that gains small watershed surface runoff contribution

NWB	Number of groundwater nodes that correspond with the small watershed
IWB	Groundwater node number small watershed baseflow is routed through
QMAXWB	Maximum recharge rate for each node [L^3/T]; a value of −1 is entered to specify the groundwater node that receives baseflow from the small watersheds, whereas a positive value indicates the amount of water that can percolate through the small stream to the groundwater

```
C*******************************************************************************
C
C                   INTEGRATED WATER FLOW MODEL (IWFM)
C                          *** Version ### ***
C
C*******************************************************************************
C
C                   BOUNDARY CONDITIONS DATA FILE
C                       for IWFM Simulation
C                            (Unit 8)
C
C
C              Project :  IWFM Version ### Release
C                         California Department of Water Resources
C              Filename:  BOUND.DAT
C
C*******************************************************************************
C                           File Description:
C
C   This data file contains five types of boundary conditions for each layer.
C   The boundary conditions are set as constant head, prescribed flux,
C   rating table and general head for each layer which is to be followed by
C   boundary conditions for small watershed inflow computation.
C
C*******************************************************************************
C
C                       Layer 1  Boundary Conditions
C
C   The following lists the specified flux, constant head, rating table
C   and general head boundary conditions for Layer 1
C
C-------------------------------------------------------------------------------
C             Specified flux boundary conditions specifications (Layer 1)
C
C   NQB  ;    Number of nodes with specified flux
C   FACT ;    Conversion factor for specified flux data
C              It is used to convert only the spatial component of the unit;
C              DO NOT include the conversion factor for time component of the unit.
C              * e.g. Unit of flux listed in this file        = AC-FT/MONTH
C                     Consistent unit used in simulation      = CU.FT/DAY
C                     Enter FACT (AC-FT/MONTH -> CU.FT/MONTH) = 2.29568E-05
C                      (conversion of MONTH -> DAY is performed automatically)
C   TUNIT;    Time unit of flux boundary conditions.  This should be one of the units
C             recognized by HEC-DSS that are listed in the Main Control File.
C
C  *Note* If the specified flux is zero, the nodes do not need to be specified
C-------------------------------------------------------------------------------
C   VALUE                        DESCRIPTION
C-------------------------------------------------------------------------------
     0                           / NQB
     1.0                         / FACT
                                 / TUNIT
C-------------------------------------------------------------------------------
C
C               Specified flux boundary condition data (Layer 1)
C       (Skip if there are no nodes with a specified flux, i.e. NQB = 0)
C
C   INODE;   Groundwater node with a specified flux
C   BQ   ;   Specified flux value at groundwater node INODE; [L^3/T]
C              (If less than -10000.0, then -(BQ+10000.0) indicates the column
C               number in unit 9 corresponding to the time series boundary
C               condition data)
C-------------------------------------------------------------------------------
C     INODE     BQ
C-------------------------------------------------------------------------------
*
*
C-------------------------------------------------------------------------------
C*******************************************************************************
C
C           Specified head boundary conditions specifications (Layer 1)
C
C   NHB ;    Number of groundwater nodes with specified head
C   FACT;    Conversion factor for specified head data
C-------------------------------------------------------------------------------
C   VALUE                        DESCRIPTION
C-------------------------------------------------------------------------------
     21                          / NHB
     1.0                         / FACT
C-------------------------------------------------------------------------------
C
C               Specified head boundary condition data (Layer 1)
C   (Skip if there are no nodes with a specified head, i.e. NHB = 0)
C
C   INODE;   Groundwater node with a specified head
C   BH   ;   Specified head value for node INODE relative to a common datum; [L]
C              (If less than -10000.0, then -(BH+10000.0) indicates the column
C               number in unit 9 corresponding to the time series boundary
C               condition data)
C-------------------------------------------------------------------------------
```

```
C    INODE     BH
C-------------------------------------------------------------------------------
      1        290.0
      22       290.0
      43       290.0
      64       290.0
      85       290.0
      106      290.0
      127      290.0
      148      290.0
      169      290.0
      190      290.0
      211      290.0
      232      290.0
      253      290.0
      274      290.0
      295      290.0
      316      290.0
      337      290.0
      358      290.0
      379      290.0
      400      290.0
      421      290.0
C-------------------------------------------------------------------------------
C*******************************************************************************
C
C            Rating table boundary conditions specifications (Layer 1)
C
C   NMB  ;   Number of nodes with a rating table boundary condition
C   NMTB ;   Number of points in the rating table
C   FACTH;   Conversion factor for head value
C   FACTQ;   Conversion factor for flow rate
C              It is used to convert only the spatial component of the unit;
C              DO NOT include the conversion factor for time component of the unit.
C              * e.g. Unit of flow rate listed in this file   = AC-FT/MONTH
C                     Consistent unit used in simulation      = CU.FT/DAY
C                     Enter FACT (AC-FT/MONTH -> CU.FT/MONTH) = 2.29568E-05
C                      (conversion of MONTH -> DAY is performed automatically)
C   TUNIT;    Time unit of flow rate.  This should be one of the units
C             recognized by HEC-DSS that are listed in the Main Control File.
C-------------------------------------------------------------------------------
C       VALUE                   DESCRIPTION
C-------------------------------------------------------------------------------
         0                     / NMB
         0                     / NMTB
         1.0                   / FACTH
         1.0                   / FACTQ
                               / TUNIT
C-------------------------------------------------------------------------------
C
C              Rating table boundary condition data (Layer 1)
C  (Skip if there are no nodes with rating table boundary conditions, ie. NMB = 0)
C
C   INODE;   Node number corresponding to a rating table boundary condition
C   HMTB ;   Head value; [L]
C   QMTB ;   Flow rate at the specified head HMTB; [L^3/T]
C
C-------------------------------------------------------------------------------
C   INODE       HMTB         QMTB
C-------------------------------------------------------------------------------
*
*
C-------------------------------------------------------------------------------
C*******************************************************************************
C
C            General head boundary conditions specifications (Layer 1)
C
C   NGB   ;  Number of groundwater nodes with general head boundary conditions
C   FACTH ;  Conversion factor for head
C   FACTAR;  Conversion factor for area
C-------------------------------------------------------------------------------
C       VALUE                   DESCRIPTION
C-------------------------------------------------------------------------------
        0                       / NGB
        1.0                     / FACTH
        1.0                     / FACTAR
C-------------------------------------------------------------------------------
C
C             General head boundary conditions data (Layer 1)
C  (Skip if there are no nodes with general head boundary conditions, ie. NGB = 0)
C
C
C   INODE;   Node number corresponding to the general head boundary condition
C   BH   ;   Fixed head at the distance BD from the groundwater node INODE; [L]
C              (If less than -10000.0, then -(BH+10000.0) indicates the column
C               number in unit 9 corresponding to the time series boundary
C               codition data)
C   BA;      Area of influence surrounding groundwater node INODE; [L^2]
C   BD;      Distance from the groundwater node INODE to the source of the
C             fixed head BH; [L]
```

```
C-------------------------------------------------------------------------------
C   INODE       BH        BA         BD
C-------------------------------------------------------------------------------
*
*
C*******************************************************************************
C
C                      Layer 2 Boundary Conditions
C
C   The following lists the specified flux, constant head, rating table
C   and general head boundary conditions for Layer 2
C
C-------------------------------------------------------------------------------
C            Specified flux boundary conditions specifications (Layer 2)
C
C   NQB  ;    Number of nodes with specified flux
C   FACT ;    Conversion factor for specified flux data
C              It is used to convert only the spatial component of the unit;
C              DO NOT include the conversion factor for time component of the unit.
C              * e.g. Unit of flux listed in this file        = AC-FT/MONTH
C                     Consistent unit used in simulation      = CU.FT/DAY
C                     Enter FACT (AC-FT/MONTH -> CU.FT/MONTH) = 2.29568E-05
C                      (conversion of MONTH -> DAY is performed automatically)
C   TUNIT;    Time unit of flux boundary conditions.  This should be one of the units
C             recognized by HEC-DSS that are listed in the Main Control File.
C
C  *Note* If the specified flux is zero, the nodes do not need to be specified
C-------------------------------------------------------------------------------
C   VALUE                       DESCRIPTION
C-------------------------------------------------------------------------------
*                               / NQB
*                               / FACT
*                               / TUNIT
C-------------------------------------------------------------------------------
C
C              Specified flux boundary condition data (Layer 2)
C      (Skip if there are no nodes with a specified flux, i.e. NQB = 0)
C
C   INODE;   Groundwater node with a specified flux
C   BQ   ;   Specified flux value at groundwater node INODE; [L^3/T]
C              (If less than -10000.0, then -(BQ+10000.0) indicates the column
C               number in unit 9 corresponding to the time series boundary
C               condition data)
C-------------------------------------------------------------------------------
C     INODE     BQ
C-------------------------------------------------------------------------------
*
*
C-------------------------------------------------------------------------------
C*******************************************************************************
C
C          Specified head boundary conditions specifications (Layer 2)
C
C   NHB ;    Number of groundwater nodes with specified head
C   FACT;    Conversion factor for specified head data
C-------------------------------------------------------------------------------
C   VALUE                       DESCRIPTION
C-------------------------------------------------------------------------------
*                               / NHB
*                               / FACT
C-------------------------------------------------------------------------------
C
C              Specified head boundary condition data (Layer 2)
C   (Skip if there are no nodes with a specified head, i.e. NHB = 0)
C
C   INODE;   Groundwater node with a specified head
C   BH   ;   Specified head value for node INODE relative to a common datum; [L]
C              (If less than -10000.0, then -(BH+10000.0) indicates the column
C               number in unit 9 corresponding to the time series boundary
C               condition data)
C-------------------------------------------------------------------------------
C    INODE     BH
C-------------------------------------------------------------------------------
*
*
C-------------------------------------------------------------------------------
C*******************************************************************************
C
C            Rating table boundary conditions specifications (Layer 2)
C
C   NMB  ;   Number of nodes with a rating table boundary condition
C   NMTB ;   Number of points in the rating table
C   FACTH;   Conversion factor for head value
C   FACTQ;   Conversion factor for flow rate
C              It is used to convert only the spatial component of the unit;
C              DO NOT include the conversion factor for time component of the unit.
C              * e.g. Unit of flow rate listed in this file   = AC-FT/MONTH
C                     Consistent unit used in simulation      = CU.FT/DAY
C                     Enter FACT (AC-FT/MONTH -> CU.FT/MONTH) = 2.29568E-05
C                      (conversion of MONTH -> DAY is performed automatically)
```

```
C   TUNIT;    Time unit of flow rate.  This should be one of the units
C             recognized by HEC-DSS that are listed in the Main Control File.
C-----------------------------------------------------------------------------
C       VALUE                  DESCRIPTION
C-----------------------------------------------------------------------------
*                             / NMB
*                             / NMTB
*                             / FACTH
*                             / FACTQ
*                             / TUNIT
C-----------------------------------------------------------------------------
C
C              Rating table boundary condition data (Layer 2)
C  (Skip if there are no nodes with rating table boundary conditions, ie. NMB = 0)
C
C   INODE;   Node number corresponding to a rating table boundary condition
C   HMTB ;   Head value; [L]
C   QMTB ;   Flow rate at the specified head HMTB; [L^3/T]
C
C-----------------------------------------------------------------------------
C   INODE       HMTB         QMTB
C-----------------------------------------------------------------------------
*
*
C-----------------------------------------------------------------------------
C*****************************************************************************
C
C            General head boundary conditions specifications (Layer 2)
C
C   NGB   ;  Number of groundwater nodes with general head boundary conditions
C   FACTH ;  Conversion factor for head
C   FACTAR;  Conversion factor for area
C-----------------------------------------------------------------------------
C       VALUE                  DESCRIPTION
C-----------------------------------------------------------------------------
*                              / NGB
*                              / FACTH
*                              / FACTAR
C-----------------------------------------------------------------------------
C
C             General head boundary conditions data (Layer 2)
C  (Skip if there are no nodes with general head boundary conditions, ie. NGB = 0)
C
C
C   INODE;   Node number corresponding to the general head boundary condition
C   BH   ;   Fixed head at the distance BD from the groundwater node INODE; [L]
C              (If less than -10000.0, then -(BH+10000.0) indicates the column
C               number in unit 9 corresponding to the time series boundary
C               codition data)
C   BA;      Area of influence surrounding groundwater node INODE; [L^2]
C   BD;      Distance from the groundwater node INODE to the source of the
C             fixed head BH; [L]
C-----------------------------------------------------------------------------
C   INODE       BH        BA         BD
C-----------------------------------------------------------------------------
*
*
C-----------------------------------------------------------------------------
C*****************************************************************************
C
C          Boundary Conditions for Small Watershed Inflow Computation
C
C   NTWB  ; Number of small watersheds where inflows will be computed
C            and specified as boundary flux
C   FACTA ; Conversion factor for small watershed drainage area
C   FACTQ ; Conversion factor for maximum recharge rate
C            It is used to convert only the spatial component of the unit;
C            DO NOT include the conversion factor for time component of the unit.
C            * e.g. Unit of max. recharge rate listed in this file   = AC-FT/MONTH
C                   Consistent unit used in simulation               = CU.FT/DAY
C                   Enter FACT (AC-FT/MONTH -> CU.FT/MONTH)          = 2.29568E-05
C                    (conversion of MONTH -> DAY is performed automatically)
C   TUNIT ; Time unit of max. recharge rate.  This should be one of the units
C            recognized by HEC-DSS that are listed in the Main Control File.
C   ID    ; Small watershed identification number
C   IWBS  ; Watershed group number corresponding to the watershed parameter
C            groups specified in the parameter data file Unit 7
C   AREAS ; Drainage area of the small watershed; [L^2]
C   IWBTS ; Stream node that receives the surface runoff from the small watershed
C   NWB   ; Number of groundwater nodes that receive the base flow and the
C            percolation of surface flow from the small watershed
C   IWB   ; Groundwater node number small watershed baseflow is routed through
C   QMAXWB; Maximum recharge rate for each node; [L^3/T]
C           (Enter -1 to specify which groundwater node(s) receive baseflow
C            from the small watersheds)
C
C   *Note*   Skip data input if no small watersheds are modeled (NSW=0)
C-----------------------------------------------------------------------------
C       VALUE                  DESCRIPTION
C-----------------------------------------------------------------------------
```

```
        3                    / NTWB
        1000000.0            / FACTA
        1000.0               / FACTQ
        1day                 / TUNIT
C-------------------------------------------------------------------
C ID     IWBS    AREAS   IWBTS     NWB    IWB      QMAXWB
C-------------------------------------------------------------------
  1        1      6.0     1         2      432       -1
                                           433       -1
  2        1      5.0     3         3      436       -1
                                           414       10.0
                                           392        5.0
  3        2      5.0     21        2       15       -1
                                            35        2.0
```

Time Series Boundary Condition File Unit 9

This file lists the time series data for specified head, specified flow and general head boundary conditions. The groundwater node numbers that correspond to the columns listed in this file are specified in the boundary conditions data file (Unit 8). If both specified head and specified flow boundary conditions are listed, then each column has to have either only head values or only flow rate values. The time series input boundary conditions data can be either listed in this file or in a DSS file. If a DSS file is used for data input, then the name of the DSS file and the pathnames corresponding to each of the time series data are required. It should be noted that the following example file is specified for a non-time tracking simulation since the time of the data is given as integer values.

The parameters specified in this file are as follows:

NBTSD	Number of columns
FACTHTS	Conversion factor for head values
FACTQTS	Conversion factor for the spatial component of the unit for the flow values. The time component of the unit is taken to be the interval of the time series data.
NSPHTS	Number of time steps to update the boundary condition head values. If time tracking simulation, enter any number.
NFQHTS	Repetition frequency of the time series boundary condition data (enter zero if full time series data is supplied). If time tracking simulation, enter any number.

DSSFL — If the time series data is stored in a DSS file, name of the file. Leave blank if the data is listed in the ASCII text file.

Data Input from ASCII Text File

If the time series data is listed in the same ASCII text file, then the following variables need to be populated. Otherwise, these variables should be commented out using "C", "c" or "*", and the variables in the "Data Input from DSS File" section below should be populated.

ITHTS — Time. For time tracking simulations use MM/DD/YYYY_hh:mm format, for non-time tracking simulations enter an integer number.

HQTS — Time series boundary values, [L] or [L^3/T] depending on if specified head or specified flow values are listed in a column

Data Input from DSS File

If time series data is stored in a DSS file then the following variables should be populated.

REC — Record number that coincides with the data column number for the time series data.

PATH — Pathname for the time series record that will be used for data retrieval

```
C*******************************************************************************
C
C                  INTEGRATED WATER FLOW MODEL (IWFM)
C                         *** Version ### ***
C
C*******************************************************************************
C
C                   TIME SERIES BOUNDARY CONDITION DATA
C                           for IWFM Simulation
C                               (Unit 9)
C
C
C             Project :  IWFM Version ### Release
C                        California Department of Water Resources
C             Filename:  BOUNDTSD.DAT
C
C*******************************************************************************
C                          File Description
C
C   This data file contains the time series data for the specified flow,
C   specified head and/or general head boundary conditions. The file provides
C   time series data for the groundwater nodes specified in boundary condition
C   data file (Unit 8).
C*******************************************************************************
C                    Time Series Boundary Condition Specifications
C
C   The following lists the time series values for the groundwater nodes
C   specified in Unit 8.
C
C   NBTSD  ; Number of columns (or pathnames if DSS files are used)
C   FACTHTS; Conversion factor for head values
C   FACTQTS; Conversion factor for flow values
C             It is used to convert only the spatial component of the unit;
C             DO NOT include the conversion factor for time component of the unit.
C             * e.g. Unit of flow listed in this file         = AC-FT/MONTH
C                    Consistent unit used in simulation       = CU.FT/DAY
C                    Enter FACTQTS (AC-FT/MONTH -> CU.FT/MONTH)= 2.29568E-05
C                     (conversion of MONTH -> DAY is performed automatically)
C   NSPHTS;  Number of time steps to update the time series boundary condition data
C             * Enter any number if time-tracking option is on
C   NFQHTS;  Repetition frequency of the time series boundary condition data
C             * Enter 0 if full time series data is supplied
C             * Enter any number if time-tracking option is on
C   DSSFL ;  The name of the DSS file for data input (maximum 50 characters);
C             * Leave blank if DSS file is not used for data input
C
C-------------------------------------------------------------------------------
C    VALUE                       DESCRIPTION
C-------------------------------------------------------------------------------
     5                           / NBTSD
     1.0                         / FACTHTS
     1.0                         / FACTQTS
     30                          / NSPHTS
     0                           / NFQHTS
                                 / DSSFL
C-------------------------------------------------------------------------------
C                    Time Series Boundary Condition Data
C                         (READ FROM THIS FILE)
C
C   List the time series boundary condition data below, if it will not be read
C   from a DSS file (i.e. DSSFL is left blank above).
C
C   ITHTS;  Time
C   HQTS ;  Time series boundary values; [L] or [L^3/T]
C
C--------------------------------------------------------------------------------------------
C   ITHTS   HQTS(1)  HQTS(2)  HQTS(3) ...
C--------------------------------------------------------------------------------------------
        1    8.2      7.2      6.8     5.7     4.9
       31    8.1      7.1      6.6     5.6     4.7
       61    9.3      8.3      7.8     6.7     5.7
        .     .        .        .       .       .
        .     .        .        .       .       .
        .     .        .        .       .       .
    11101    4.8      4.2      3.8     3.2     2.9
    11131    5.5      4.9      4.5     3.9     3.6
C-------------------------------------------------------------------------------
C                    Pathnames for Time Series Boundary Condition Data
C                                (READ FROM DSS FILE)
C
C   List the pathnames for the time series boundary condition data below, if it will be read
C   from a DSS file (i.e. DSSFL is specified above).
C
C   REC  ;  Time series record number
C   PATH ;  Pathname for the time series record
C--------------------------------------------------------------------------------------------
C   REC       PATH
C--------------------------------------------------------------------------------------------
*
*
```

Printing Control File Unit 10

This data file contains the instructions for printing groundwater, stream and tile drain/subsurface irrigation hydrograph information as well as subsidence, and the flow at boundary nodes and element faces. The tile drain/subsurface irrigation hydrographs are printed to Unit 45, stream hydrographs to Unit 46 and the groundwater hydrographs to Unit 47. Subsidence is printed to Unit 41, the element face flows are printed to Unit 43 and the boundary node flows to Unit 44.

Groundwater hydrographs can be printed at specified groundwater nodes or at locations defined by x-y coordinates and layer number. The data file requires the user to specify the number of groundwater hydrographs to be printed (NOUTH) and the conversion factor for nodal coordinates (FACT). If the groundwater hydrographs are required for specified groundwater nodes at specified layers, then FACT should be set to zero. If the groundwater hydrographs are required for specified x-y coordinates and specified layers, then FACT should be set to the actual conversion factor. If hydrographs at a mixture of groundwater nodes and x-y coordinate locations are required, then groundwater nodes should be treated as x-y locations and FACT should be set to 0.0. If input data is based on node numbers, the spaces reserved for x and y coordinates must be left blank. NOUTH must be set to zero if no groundwater hydrographs are required. To print the average head for all layers, IOUTHL is set to zero. If hydrographs at a layer other than the top most layer are desired, then enter the layer number and the node number at the top most layer. For instance, to print hydrographs at node 35 at layers 1 and 2 specify two entries: (i) IOUTHL = 1 and IOUTH = 35 and (ii) IOUTHL = 2 and

IOUTH = 35. The procedure is the same if hydrographs at multiple layers at an x-y location are desired.

Next, the number of stream hydrographs (NOUTR), stream hydrograph output values (IHSQR) and stream node numbers must be specified. The stream hydrographs can represent stream flows (IHSQR=0) or stream surface elevations (IHSQR=1). If no stream hydrographs are required, then NOUTR must be set to zero.

To print out tile drain/subsurface irrigation hydrographs number of required hydrographs (NOUTTD) and the corresponding groundwater node numbers (IOUTTD) should be specified. If no tile drain/subsurface irrigation hydrographs are required, NOUTTD should be set to zero.

Printing of subsidence is similar to the printing of groundwater hydrographs. The user may request to print subsidence values at specified x-y coordinates or at grid nodes. In any case, the number of locations for which subsidence will be printed (NOUTS) must be specified along with the conversion factor (FACT) for the coordinates of the locations for subsidence printing. If subsidence will be printed at grid nodes, then FACT must be set to 0.0, otherwise a proper coordinate conversion factor must be specified. Then, for each location where a subsidence print-out is required, the aquifer layer number (IOUTSL), and either the x (X) and y-coordinates (Y) of the location or the groundwater node number (IOUTS) must be specified, depending on the value specified for FACT. IOUTSL can be set to any aquifer layer number. Alternatively, it can be set to 0 to print-out the total subsidence (summation of the subsidence at all aquifer layers) at the specified location. If no subsidence printing is required NOUTS must be set to zero, FACT to any number, and no entries must be made for IOUTSL, X, Y and IOUTS variables.

For boundary node flow printing, number of hydrographs (NOUTB) and corresponding groundwater boundary node (IOUTB) and layer number (IOUTBL) should be specified. The nodes for which flow printing are requested should be specified boundary conditions in file Unit 8.

To print out the flow rates at element faces, number of element faces (NOUTF) for print-out, the aquifer layer numbers in which the element faces is located (IOUTFL), and the node numbers that identify each of the element faces (IOUTFA and IOUTFB) should be specified.

The following variables are located in this input file for the purposes of specifying hydrograph printing options:

NOUTH	Total number of groundwater hydrographs to be printed; set NOUTH = 0 if no groundwater hydrograph data is to be printed
FACT	Factor to convert nodal coordinates into simulation unit of length. If FACT = 0.0 the input data is by nodes; if FACT > 0.0 the input data is by x-y coordinates
IOUTHL	Layer number (IOUTHL = 0 to print average head for all layers)
X	The x-coordinate of the well location (specify only if FACT > 0.0), [L]
Y	The y-coordinate of the well location (specify only if FACT > 0.0), [L]
IOUTH	Groundwater node number (specify only if FACT = 0.0)

NOUTR	Total number of stream hydrographs to be printed; NOUTR = 0 if no stream hydrograph data is to be printed
IHSQR	Switch for the output of stream surface elevations or stream flows; IHSQR = 0 if output of stream flows is desired, IHSQR = 1 if output of stream surface elevations is desired
IOUTR	Stream node number for printing hydrograph output
NOUTTD	Total number of tile drain/subsurface irrigation hydrographs to be printed; NOUTTD = 0 if no tile drain/subsurface irrigation hydrograph is to be printed
IOUTTD	Groundwater node number corresponding to the tile drain/subsurface irrigation location for hydrograph printing
NOUTS	Total number of subsidence data to be printed; NOUTS = 0 if no subsidence data is to be printed
FACT	Factor to convert nodal coordinates into simulation unit of length. If FACT = 0.0 the subsidence print-out locations are by nodes; if FACT > 0.0 the they are by x-y coordinates
IOUTSL	Layer number (IOUTSL = 0 to print total subsidence for all layers)
X	The x-coordinate of the location for which subsidence will be printed (specify only if FACT > 0.0), [L]
Y	The y-coordinate of the location for which subsidence will be printed (specify only if FACT > 0.0), [L]
IOUTS	Groundwater node number for subsidence print-out (specify only if FACT = 0.0)

NOUTB	Total number of flow hydrographs at boundary nodes to be printed; NOUTB = 0 if no hydrographs at boundary nodes are to be printed
IOUTBL	Layer number of the groundwater boundary node for hydrograph printing
IOUTB	Groundwater node number for boundary node hydrograph printing
NOUTF	Number of element faces for flow printing
IOUTFL	Aquifer layer number that an element face is located
IOUTFA	The first groundwater node number that defines the element face
IOUTFB	The second groundwater node number that defines the element face

```
C*******************************************************************************
C
C                   INTEGRATED WATER FLOW MODEL (IWFM)
C                          *** Version ### ***
C
C*******************************************************************************
C
C                     PRINT CONTROL DATA FILE
C                       for IWFM Simulation
C                            (Unit 10)
C
C
C              Project:  IWFM Version ### Release
C                        California Department of Water Resources
C              Filename: PRINT.DAT
C
C*******************************************************************************
C                              File Description:
C
C   This data file contains the print output control data including a list of
C   the groundwater, stream and tile drain nodes for which hydrographs will be
C   printed,and a list of the boundary nodes for which groudwater flow will be
C   printed.
C
C*******************************************************************************
C           Groundwater Hydrograph Print Control Specifications
C
C   The following lists the node and layer numbers for which groundwater
C   hydrograph will be printed
C
C   NOUTH;   Total number of hydrographs to be printed
C             (set NOUTH = 0 if no hydrograph data is to be printed)
C   FACT ;   Conversion factor for nodal coordinates
C             If FACT = 0.0 the input data is by nodes
C             If FACT > 0.0 the input data is by X-Y coordinates
C-------------------------------------------------------------------------------
C   VALUE                      DESCRIPTION
C-------------------------------------------------------------------------------
    7                          / NOUTH
    0.0                        / FACT
C-------------------------------------------------------------------------------
C
C   The following lists the layer number and groundwater node number for
C   each groundwater hydrograph to be printed (skip if no hydrographs are
C   to be printed, ie. NOUTH = 0)
C
C   IOUTHL;  Layer number (IOUTHL = 0 to print average head for all layers)
C   X     ;  The x-coordinate of the  well location (specify ONLY if FACT > 0.0); [L]
C   Y     ;  The y-coordinate of the  well location (specify ONLY if FACT > 0.0); [L]
C   IOUTH ;  Groundwater node number (specify ONLY if FACT = 0.0)
C
C-------------------------------------------------------------------------------
C       IOUTHL         X           Y            IOUTH
C-------------------------------------------------------------------------------
          1                                    433
          1                                    412
          1                                    391
          2                                    76
          2                                    55
          2                                    34
          2                                    13
C*******************************************************************************
C               Stream Hydrograph Print Control Specifications
C
C   NOUTR;   Total number of hydrographs to be printed
C             (NOUTR = 0 if no stream hydrograph data is to be printed)
C   IHSQR;   Switch for the output of stream surface elevations or stream flows;
C             IHSQR = 0 if output of stream flows is desired,
C             IHSQR = 1 if output of stream surface elevations is desired
C-------------------------------------------------------------------------------
C   VALUE                      DESCRIPTION
C-------------------------------------------------------------------------------
      23                       / NOUTR
      0                        / IHSQR
C-------------------------------------------------------------------------------
C
C   The following lists the stream node number for hydrograph to be printed
C   (skip if no hydrographs are to be printed, ie. NOUTR = 0)
C
C   IOUTR;   Stream node number for printing hydrograph output
C-------------------------------------------------------------------------------
C         IOUTR
C-------------------------------------------------------------------------------
           1
           2
           3
           4
           5
           6
           7
           8
           9
           10
           11
           12
           13
           14
           15
```

```
          16
          17
          18
          19
          20
          21
          22
          23
C*******************************************************************************
C    Tile Drain/Subsurface Irrigation Hydrograph Print Control Specifications
C
C   NOUTTD;  Total number of tile drain/subsurfae irrigation hydrographs to be printed
C             (set NOUTTD = 0 if no hydrographs are to be printed)
C-------------------------------------------------------------------------------
C   VALUE                        DESCRIPTION
C-------------------------------------------------------------------------------
      6                          / NOUTTD
C-------------------------------------------------------------------------------
C
C
C   The following lists the tile drain/subsurface irrigation node number (i.e.
C    corresponding groundwater node) for hydrograph to be printed.
C   (skip if no hydrographs are to be printed, ie. NOUTTD = 0)
C
C   IOUTTD;   Tile drain/subsurafe irrigation node number for printing hydrograph output
C-------------------------------------------------------------------------------
C         IOUTTD
C-------------------------------------------------------------------------------
          6
          69
          132
          195
          258
          321
C*******************************************************************************
C              Subsidence Print Control Specifications
C
C   The following lists the node and layer numbers for which subsidence
C   will be printed
C
C   NOUTS;   Total number of subsidence data to be printed
C             (set NOUTS = 0 if no subsidence data is to be printed)
C   FACT ;   Conversion factor for nodal coordinates
C             If FACT = 0.0 the input data is by nodes
C             If FACT > 0.0 the input data is by X-Y coordinates
C-------------------------------------------------------------------------------
C   VALUE                        DESCRIPTION
C-------------------------------------------------------------------------------
    0                            / NOUTS
    1.0                          / FACT
C-------------------------------------------------------------------------------
C
C   The following lists the layer number and groundwater node number for
C   each subsidence data to be printed (skip if no subsidence data is
C   to be printed, ie. NOUTS = 0)
C
C   IOUTSL;  Layer number (IOUTSL = 0 to print total subsidence for all layers)
C   X     ;  The x-coordinate of the subsidence data location (specify ONLY if FACT > 0.0); [L]
C   Y     ;  The y-coordinate of the subsidence data location (specify ONLY if FACT > 0.0); [L]
C   IOUTS ;  Groundwater node number (specify ONLY if FACT = 0.0)
C
C-------------------------------------------------------------------------------
C       IOUTSL         X           Y            IOUTS
C-------------------------------------------------------------------------------
*
*
C*******************************************************************************
C                        Boundary Node Flow Print Control
C
C   The following lists the boundary nodes and layers for which flow values
C     will be printed
C
C   NOUTB;   Total number of flow hydrographs to be printed (set NOUTB = 0
C             if no flow hydrographs are to be printed)
C-------------------------------------------------------------------------------
C   VALUE                        DESCRIPTION
C-------------------------------------------------------------------------------
      6                          / NOUTB
C-------------------------------------------------------------------------------
C
C   The following lists the layer number and groundwater node number for
C   each flow hydrograph to be printed (skip if no flow hydrograph is
C   to be printed, ie. NOUTB = 0)
C
C   IOUTBL;  Layer number
C   IOUTB;   Groundwater node number for flow hydrograph output
C-------------------------------------------------------------------------------
C   IOUTBL          IOUTB
C-------------------------------------------------------------------------------
      1               1
      1              22
      1              85
      1             148
      1             211
      1             274
C*******************************************************************************
C                         Element Face Flow Print Control
C
```

```
C   The following lists the element faces for which the flow output is desired
C
C-------------------------------------------------------------------------------
C
C   NOUTF  ; Number of element faces for flow output
C
C-------------------------------------------------------------------------------
C   VALUE                       DESCRIPTION
C-------------------------------------------------------------------------------
      3                         /NOUTF
C-------------------------------------------------------------------------------
C
C   The following lists the layer number and groundwater node numbers that
C   defines the element face for each face flow hydrograph to be printed (skip
C   if no element face flow hydrograph is to be printed, ie. NOUTFF = 0)
C
C   IOUTFL ; Layer number
C   IOUTFA ; The first groundwater node number that defines the element face
C   IOUTFB ; The second groundwater node number that defines the element face
C-------------------------------------------------------------------------------
C   IOUTFL     IOUTFA     IOUTFB
C-------------------------------------------------------------------------------
      1          89         90
      1          91         90
      2          91         90
```

Initial Conditions File   Unit 11

This data file contains the initial aquifer head values for each node and layer, initial soil moisture conditions for root zone, unsaturated zone and small watersheds and initial lake surface elevations. It also includes initial interbed thickness and initial pre-consolidation head values for each layer if it is desired to overwrite the values set in parameter data file.

Initial Aquifer Head Values

Initial aquifer head values must be specified for all nodes in each aquifer layer modeled. If the initial groundwater head specified is below the bottom elevation of the aquifer layer, then IWFM sets it to the elevation of the bottom of the aquifer. The list below describes the input values to define the initial aquifer head values. All values are to be specified for each layer modeled in IWFM.

FACT	Conversion factor for initial heads
HP	Initial head at each groundwater node, [L]

Initial Soil Moisture Conditions

Initial soil moisture conditions are specified in this file for the root zone, unsaturated zone and small stream watersheds modeled. If the subregion number for initial root zone soil moisture, element number for initial unsaturated zone soil moisture or small watershed number is specified as zero, then the values specified are used for all subregions, elements or small watersheds, respectively. Initial root zone moisture can be specified as volume or as a fraction of the average field capacity for each subregion and land use type. The following variables are used to input initial soil moisture conditions:

FACTSM	Conversion factor for volumetric initial root zone moisture; if initial root zone moisture is to be specified as a fraction of the root zone depth, then specify a value 0.0
ID	Subregion number for initial soil moisture in root zone or element number for initial soil moisture in unsaturated zone; specify as zero if the following initial moisture conditions are to be used for all subregions for initial root zone moisture or for all elements for initial unsaturated zone moisture
SOILM	Initial soil moisture as a volume or as a fraction of the field capacity for each subregion, land use type and soil group, [L^3] or [L/L] depending on the value of FATSM
FACT	Weighting factor for initial unsaturated zone soil moisture or conversion factor for initial groundwater storage for small watersheds
UNSATM	Initial soil moisture for each layer of the unsaturated zone as fraction of the total porosity given for the unsaturated layers, [L/L]
IS	Small stream watershed number; specify as zero if the values for SOILS and GWSTS are to be used for all small stream watersheds
SOILS	Initial soil moisture at the small watershed as a fraction of field capacity, [L/L]
GWSTS	Initial groundwater storage for each watershed, [L]

Initial Lake Elevations

Initial lake elevations are also listed in this file. This section should be skipped if there are no lakes being modeled. The following variables are required to be set:

FACT	Conversion factor for initial lake elevations
ILAKE	Sequential lake number
HLAKE	Initial lake elevation, [L]

Interbed Thickness for each Layer

All values are specified for each layer modeled in IWFM. Interbed thicknesses are used to compute land subsidence. This part of the data file is used if the initial interbed depths defined in Unit 7 are chosen to be overwritten.

FACT	Conversion factor for initial interbed thickness. If set to 0.0 for any aquifer layer, then IWFM will not attempt to read the initial interbed thicknesses for that layer.
DC	Initial interbed thicknesses at corresponding groundwater nodes, [L]

Pre-Consolidation Head values for Land Subsidence

All pre-consolidation head values are specified for each layer modeled in IWFM in the parameter file (Unit 7). This section of the initial conditions data file is used if pre-consolidation heads specified previously are to be overwritten.

FACT	Conversion factor for pre-consolidation head values. If set to 0.0 for any aquifer layer, then IWFM will not attempt to read the pre-consolidation head values for that layer.
HC	Pre-consolidation head at corresponding groundwater node, [L]

```
C*******************************************************************************
C
C                  INTEGRATED WATER FLOW MODEL (IWFM)
C                         *** Version ### ***
C
C*******************************************************************************
C
C                  INITIAL CONDITIONS DATA FILE
C                      for IWFM Simulation
C                           (Unit 11)
C
C
C             Project:  IWFM Version ### Release
C                       California Department of Water Resources
C             Filename: INIT.DAT
C
C*******************************************************************************
C                         File Description
C
C   This data file contains the initial head at each groundwater node for
C   each aquifer (layer) modeled; the initial soil moisture values for root zone,
C   unsaturated zone and small watersheds; initial interbed thickness to overwrite
C   the values set in parameter data file; initial preconsolidation head values
C   that overwrite the values et in the parameter data file and initial lake
C   elevations.
C
C*******************************************************************************
C                      Initial Aquifer Head Values
C
C   FACT;  Conversion factor for initial heads
C   HP;    Initial head at corresponding groundwater node; [L]
C-------------------------------------------------------------------------------
C   Layer 1:
C
C   VALUE                       DESCRIPTION
C-------------------------------------------------------------------------------
     1.0                        / FACT
C-------------------------------------------------------------------------------
C    Initial Head at Layer 1
C    HP
C-------------------------------------------------------------------------------
   605.70    605.78    622.82    576.75    492.61    540.47    540.05    525.74    430.35    500.23
   387.98    535.68    770.63    720.75    419.39    432.54    378.50    665.61    715.66    720.67
        .         .         .         .         .         .         .         .         .         .
        .         .         .         .         .         .         .         .         .         .
        .         .         .         .         .         .         .         .         .         .
   880.04   1715.75    671.79    495.93    495.62   2009.94    640.92    500.33    827.41   1347.38
  1006.64   1312.05   1412.70
C-------------------------------------------------------------------------------
C   Layer 2
C
C   VALUE                       DESCRIPTION
C-------------------------------------------------------------------------------
     1.0                        / FACT
C-------------------------------------------------------------------------------
C    Initial Head at Layer 2
C    HP
C-------------------------------------------------------------------------------
   555.45    593.96    620.51    575.32    493.74    538.18    538.10    481.44    432.95    498.63
   392.65    488.99    722.07    671.21    421.54    431.37    381.21    617.24    666.88    671.61
        .         .         .         .         .         .         .         .         .         .
        .         .         .         .         .         .         .         .         .         .
        .         .         .         .         .         .         .         .         .         .
   724.00   1400.00    501.95    463.88    100.00   1800.00    561.68    500.90    600.00   1199.00
   876.00   1200.00   1300.00
C-------------------------------------------------------------------------------
C   Layer 3
C
C   VALUE                       DESCRIPTION
C-------------------------------------------------------------------------------
     1.0                        / FACT
C-------------------------------------------------------------------------------
C    Initial Head at Layer 3
C    HP
C-------------------------------------------------------------------------------
   555.00    555.00    555.00    415.00    496.26    532.91    415.00    475.00    439.00    495.00
   270.00    485.00    720.00    670.00    426.60    428.75    387.56    615.00    665.00    541.45
        .         .         .         .         .         .         .         .         .         .
        .         .         .         .         .         .         .         .         .         .
        .         .         .         .         .         .         .         .         .         .
   445.25   1400.00    497.86    462.46    451.16   1800.00    557.20    502.77    600.00   1199.00
   876.00   1200.00   1300.00
C-------------------------------------------------------------------------------
C*******************************************************************************
C                          Initial Soil Moisture Conditions
C
C   Following are the initial soil moisture conditions for the root zone, the
C   unsaturated zone, and the small watersheds in the model. These set of data
C   need to be provided only if there is at least one rain gage that is specified
C   in Pre-processor. Skip if no rain gage is specified.
```

```
C
C-------------------------------------------------------------------------------
C                            Initial Soil Moisture Condition
C                                    For Root Zone
C
C   FACTSM;     Conversion factor for volumetric initial root zone moisture
C                (enter 0.0 if initial moisture condition is given as a
C                 dimensionless quantity)
C-------------------------------------------------------------------------------
C   VALUE                       DESCRIPTION
C-------------------------------------------------------------------------------
     1.0                        / FACTSM
C-------------------------------------------------------------------------------
C
C   ID   ;   Subregion No. (0 if following values are to be used for all subregions)
C   SOILM;   Initial root zone moisture for corresponding land use type
C              for each soil group; [L^3] or [L/L]
C
C-------------------------------------------------------------------------------
C                                   Land use type
C           -------------------------------------------------------------------
C    ID           Ag.         Urban         Native Veg.    Riparian Veg.
C-----------------------------------------------------------------------------
     0            0.0         0.0           0.0            0.0
                  0.0         0.0           0.0            0.0
                  0.0         0.0           0.0            0.0
                  0.0         0.0           0.0            0.0
C*******************************************************************************
C                            Initial Soil Moisture Condition
C                                 For Unsaturated Zone
C
C   FACT;    Weighting factor for initial unsaturated zone soil moisture
C-------------------------------------------------------------------------------
C   VALUE                       DESCRIPTION
C-------------------------------------------------------------------------------
     1.0                        / FACT
C-------------------------------------------------------------------------------
C
C   ID    ;  Element No. (0, if following values are to be used for all elements)
C   UNSATM;  Initial soil moisture content for each layer of the
C             unsaturated zone [L/L]
C-------------------------------------------------------------------------------
C                              Unsaturated Layers
C         -------------------------------------------------------------------
C  ID             1           2   ......
C-------------------------------------------------------------------------------
    0             0.0         0.0
C*******************************************************************************
C                            Initial Soil Moisture Conditions
C                                 For Small Watersheds
C
C   FACT;  Conversion factor for initial groundwater storage for each of the
C            small watershed
C-------------------------------------------------------------------------------
C   VALUE                       DESCRIPTION
C-------------------------------------------------------------------------------
     1.0                        / FACT
C-------------------------------------------------------------------------------
C
C   IS   ;   Watershed No (0, if following values are to be used for all watersheds)
C   SOILS;   Initial soil moisture content for for each watershed; [L/L]
C   GWSTS;   Initial groundwater storage for each watershed; [L]
C-------------------------------------------------------------------------------
C     IS              SOILS                 GWSTS
C-------------------------------------------------------------------------------
      0               0.0                   10.0
C-------------------------------------------------------------------------------
C*******************************************************************************
C                       Initial Lake Elevations
C                 (Skip if there are no lakes simulated)
C
C   FACT ;  Conversion factor for initial lake elevations
C   ILAKE;  Sequential lake number
C   HLAKE;  Initial lake elevations; [L]
C-------------------------------------------------------------------------------
C   VALUE                       DESCRIPTION
C-------------------------------------------------------------------------------
      1.0                       /FACT
C-------------------------------------------------------------------------------
C    ILAKE     HLAKE
C-------------------------------------------------------------------------------
      1       280.0
C-----------------------------------------------------------------------------------
C*******************************************************************************
C                    Interbed Thickness for Each Layer
C
C   The following lists the initial Interbed Thicknesses for each node (in
C   sequential order) to overwrite what is specified in the parameter file.
C
C   FACT;   Conversion factor for initial interbed thickness
```

```
C           (enter 0.0 if the values specified in the parameter file will not
C            be overwriten).
C   DC  ;   Initial interbed thickness; [L]
C-----------------------------------------------------------------------------
C   Layer 1:
C
C   VALUE                      DESCRIPTION
C-----------------------------------------------------------------------------------------------
     1.0                       / FACT
C-----------------------------------------------------------------------------
C    Initial interbed thickness at Layer 1
C    DC
C-----------------------------------------------------------------------------
   13.00     12.00     12.00     12.00     12.00     19.00     12.00      7.00     14.00     11.00
   22.00     26.00     23.00      8.00      8.00     13.00     23.00     10.00      8.00      8.00
       .         .         .         .         .         .         .         .         .         .
       .         .         .         .         .         .         .         .         .         .
       .         .         .         .         .         .         .         .         .         .
   17.00     33.00    101.00    104.00    105.00     42.00     84.00     85.00     81.00     65.00
   65.00     63.00     63.00
C-----------------------------------------------------------------------------
C    Layer 2:
C
C    VALUE                      DESCRIPTION
C-----------------------------------------------------------------------------
     1.0                       / FACT
C-----------------------------------------------------------------------------
C    Initial interbed thickness at Layer 2
C    DC
C-----------------------------------------------------------------------------
    4.00      4.00      4.00      5.00      4.00      3.00      4.00      4.00      4.00      3.00
    5.00      5.00      5.00      5.00      5.00      4.00      5.00      4.00      5.00      5.00
       .         .         .         .         .         .         .         .         .         .
       .         .         .         .         .         .         .         .         .         .
       .         .         .         .         .         .         .         .         .         .
   35.00      0.00    135.00    132.00      0.00      0.00    129.00    131.00      0.00      0.00
    0.00      0.00      0.00
C-----------------------------------------------------------------------------
C   Layer 3
C
C   VALUE                      DESCRIPTION
C-----------------------------------------------------------------------------
      0.0                      /FACT
C ----------------------------------------------------------------------------
C    Interbed Thickness for Layer 3
C    DC
C-----------------------------------------------------------------------------
*
*
C-----------------------------------------------------------------------------
C*****************************************************************************
C             Initial Preconsolidation Head Values for Land Subsidence
C
C   The following lists the preconsolidation head for each groundwater node
C   (in sequential order) to overwrite the values specified in parameter file.
C
C   FACT;  Conversion factor for preconsolidation head
C           (enter 0.0 if the values specified in the parameter file will not
C            be overwriten).
C   HC  ;  Initial preconsolidation head at corresponding groundwater node; [L]
C
C-----------------------------------------------------------------------------
C   Layer 1
C
C   VALUE                      DESCRIPTION
C-----------------------------------------------------------------------------
      0.0                      /FACT
C-----------------------------------------------------------------------------
C    Initial preconsolidation head at Layer 1
C    HC
C-----------------------------------------------------------------------------
*
*
C-----------------------------------------------------------------------------
C   Layer 2
C
C   VALUE                      DESCRIPTION
C-----------------------------------------------------------------------------
      1.0                      /FACT
C-----------------------------------------------------------------------------
C    Initial preconsolidation head at Layer 2
C    HC
C-----------------------------------------------------------------------------
  455.00    494.00    521.00    475.00    394.00    438.00    438.00    381.00    333.00    399.00
  293.00    389.00    622.00    571.00    322.00    331.00    281.00    517.00    567.00    572.00
       .         .         .         .         .         .         .         .         .         .
       .         .         .         .         .         .         .         .         .         .
       .         .         .         .         .         .         .         .         .         .
  407.00    750.00    452.00    414.00    340.00    750.00    522.00    451.00    506.00    750.00
  750.00    750.00    750.00
```

```
C-----------------------------------------------------------------------------
C   Layer 3
C
C   VALUE                      DESCRIPTION
C-----------------------------------------------------------------------------
      1.0                      /FACT
C-----------------------------------------------------------------------------
C    Preconsolidation Head at Layer 3
C    HC
C-----------------------------------------------------------------------------
  412.00    488.00    515.00    472.00    396.00    433.00    434.00    378.00    339.00    395.00
  303.00    384.00    585.00    431.00    327.00    329.00    288.00    370.00    488.00    441.00
       .         .         .         .         .         .         .         .         .         .
       .         .         .         .         .         .         .         .         .         .
       .         .         .         .         .         .         .         .         .         .
  445.00    546.00    498.00    462.00    340.00    563.00    557.00    503.00    521.00    750.00
  750.00    750.00    750.00
```

Supply Adjustment Specifications File Unit 12

This data file contains the time series specifications for the adjustment of surface water diversions and groundwater pumping in order to minimize the discrepancy between the agricultural and urban water demand and water supply. The data contains information to specify if a diversion or pumping should be adjusted to meet agricultural demand, urban demand or both. Each diversion or pumping scheme is associated with a column in this file through the surface water diversion specification file (Unit 25) or through the pumping specification file (Unit 23). This file is required when KOPTDV is set to a value other than 00 in the main input file (Unit 5). The time series supply adjustment specifications data can be either listed in this file or in a DSS file. If a DSS file is used for data input, then the name of the DSS file and the pathnames corresponding to each of the time series data are required. Also note that the file example given below specifies time series data that are constant throughout the simulation period by setting the year of the time series data to a value (year 2100) that covers the entire period.

The following variables are required to be set:

NCOLADJ	Number of columns in the supply adjustment specifications data file
NSPADJ	Number of time step to update the supply adjustment specifications data. If time tracking simulation, enter any number.
NFQADJ	Repetition frequency of the supply adjustment specifications data (enter zero if full time series data is supplied). If time tracking simulation, enter any number.

DSSFL — If the time series data is stored in a DSS file, name of the file. Leave blank if the data is listed in the ASCII text file.

Data Input from ASCII Text File

If the time series data is listed in the same ASCII text file, then the following variables need to be populated. Otherwise, these variables should be commented out using "C", "c" or "*", and the variables in the "Data Input from DSS File" section below should be populated.

ITADJ — Time. For time tracking simulations use MM/DD/YYYY_hh:mm format, for non-time tracking simulations enter an integer number.

KADJ — Supply adjustment option specified as a two digit number; first digit from left specifies if the water supply (diversion or pumping) is to be adjusted to meet agricultural supply requirement (0 = no adjustment is required; 1 = adjust water supply to meet agricultural water requirement); second digit from left specifies if the water supply (diversion or pumping) is to be adjusted to meet urban supply requirement (0 = no adjustment is required; 1 = adjust water supply to meet urban supply requirement)

Data Input from DSS File

If time series data is stored in a DSS file then the following variables should be populated:

REC	Record number that coincides with the data column number for the time series data.
PATH	Pathname for the time series record that will be used for data retrieval

```
C*******************************************************************************
C
C                   INTEGRATED WATER FLOW MODEL (IWFM)
C                          *** Version ### ***
C
C*******************************************************************************
C
C                      SUPPLY ADJUSTMENT SPECIFICATIONS
C                            for IWFM Simulation
C                                 (Unit 12)
C
C
C              Project :  IWFM Version ### Release
C                         California Department of Water Resources
C              Filename:  SUPPLYADJ.DAT
C
C*******************************************************************************
C                             File Description
C
C   This data file contains the time series specifications for the adjustment of
C   surface water diversions and groundwater pumping. The data contains information
C   to specify if a diversion or pumping should be adjusted to meet agricultural
C   demand, urban demand or both. This file is required when KOPTDV is set to a
C   value other than 00 in the main input file (Unit 5).
C
C*******************************************************************************
C                     Supply Adjustment Specifications
C
C   The following lists the time-series specifications for supply adjustment options
C   for surface water diversions and groundwater pumping.
C
C   NCOLADJ;  Number of columns (or pathnames if DSS files are used) in the supply
C              adjustment specifications data file
C   NSPADJ ;  Number of time steps to update the supply adjustment specifications data
C              * Enter any number if time-tracking option is on
C   NFQADJ ;  Repetition frequency of the supply adjustment specifications data
C              * Enter 0 if full time series data is supplied
C              * Enter any number if time-tracking option is on
C   DSSFL  ;  The name of the DSS file for data input (maximum 50 characters);
C              * Leave blank if DSS file is not used for data input
C
C-------------------------------------------------------------------------------
C    VALUE                DESCRIPTION
C-------------------------------------------------------------------------------
     4                    /NCOLADJ
     1                    /NSPADJ
     1                    /NFQADJ
                          /DSSFL
C*******************************************************************************
C                     Supply Adjustment Specifications Data
C                          (READ FROM THIS FILE)
C
C   List the time series supply adjustment specifications data below, if it will
C   not be read from a DSS file (i.e. DSSFL is left blank above).
C
C   ITADJ;  Time
C   KADJ;   Supply adjustment option. Enter two digits as follows:
C           1st digit(from left):
C                  0 = NO adjustment of supply to meet agricultural water demand
C                  1 = YES, adjust supply to meet agricultural water demand
C           2nd digit(from left):
C                  0 = NO adjustment of supply to meet urban water demand
C                  1 = YES, adjust supply to meet urban water demand
C
C-------------------------------------------------------------------------------
C  ITADJ             KADJ
C-------------------------------------------------------------------------------
 09/30/2100_24:00    00    01    10    11
C-------------------------------------------------------------------------------
C                     Pathnames for Supply Adjustment Specifications Data
C                                 (READ FROM DSS FILE)
C
C   List the pathnames for supply adjustment specifications data below, if it will
C   be read from a DSS file (i.e. DSSFL is specified above).
C
C   REC  ;  Time series record number
C   PATH ;  Pathname for the time series record
C
C--------------------------------------------------------------------------------------
C   REC       PATH
C--------------------------------------------------------------------------------------
*
*
```

Land Use Data File Unit 13

The land use data file specifies the area (or fraction of area relative to the total elemental area) associated with each land use type within an element. The four land use types modeled in IWFM are agricultural, urban, native and riparian lands. Elemental areas must be specified for each land use type at all specified time steps. If a land use type does not exist within an element, define the area as zero. Similarly, if the user does not want to model a specified land use type, the area should be entered as zero for all elements. A pre-processor is available that interpolates and extrapolates survey year land use areas given that a complete time-series data set of subregional areas is provided.

The factor to convert land use areas to the simulation unit of area, the number of time steps to update the data, and the repetition frequency of the data file must be specified in this file. This information is followed by the value that represents the time (ITLN), as well as all elements and the land use areas within each element. In non-time tracking simulations, the time series data set can be represented by any frequency, as long as the correct time step controls are set (NSPLN and NFQLN) and they correspond to the time step controls set in crop acreage data file (Unit 14). In time tracking simulations the time series land use data can be either listed in this file or in a DSS file. If a DSS file is used for data input, then the name of the DSS file and the pathnames corresponding to each of the time series data are required. The input to Unit 13 is as follows:

FACTLN	Conversion factor for land use area; a value of 0.0 should be entered when land use areas are specified as a fraction of the total elemental area

NSPLN	Number of time steps to update the land use data; the value must equal the number of time steps to update the crop acreage data file (NSPCR in Unit 14). If time tracking simulation, enter any number.
NFQLN	Repetition frequency of the land use data; NFQLN must equal NFQCR specified in Unit 14 and NFQLN is set to zero for a time series data file that includes the entire simulation period. If time tracking simulation, enter any number.
DSSFL	If the time series data is stored in a DSS file, name of the file. Leave blank if the data is listed in the ASCII text file.

Data Input from ASCII Text File

If the time series data is listed in the same ASCII text file, then the following variables need to be populated. Otherwise, these variables should be commented out using “C”, “c” or “*”, and the variables in the “Data Input from DSS File” section below should be populated.

ITLN	Time. For time tracking simulations use MM/DD/YYYY_hh:mm format, for non-time tracking simulations enter an integer number.
IE	Element identification number
ALAND	Area corresponding to each land use type (agricultural, urban, native vegetation and riparian vegetation) over an element, [L^2]

Data Input from DSS File

If time series data is stored in a DSS file then the following variables should be populated. The element and the land use type identification numbers should be entered sequentially such that the land use type changes first.

IE	Element identification number
LUTYPE	Land use type. 1 = agricultural land, 2 = urban land, 3 = native vegetation land, 4 = riparian vegetation land.
PATH	Pathname for the time series data for the corresponding element and land use type combination

```
C*******************************************************************************
C
C             INTEGRATED WATER FLOW MODEL (IWFM)
C                    *** Version ### ***
C
C*******************************************************************************
C
C                   LAND USE DATA FILE
C                  for IWFM Simulation
C                       (Unit 13)
C
C
C            Project :  IWFM Version ### Release
C                       California Department of Water Resources
C            Filename:  LANDUSE.DAT
C
C*******************************************************************************
C                         File Description
C
C   This data file contains the land use distribution for each element
C   for the simulation period.
C
C*******************************************************************************
C                          Land Use Data Specifications
C
C   FACTLN;   Conversion factor for land use area
C              * Enter 0.0 if land use distribution is given as a fraction of element area
C   NSPLN ;   Number of time steps to update the land use data
C              (Note: This value should be equal to NSPCR in crop acreage data file)
C              * Enter any number if time-tracking option is on
C   NFQLN ;   Repetition frequency of the land use data
C              (Note: This value should be equal to NFQCR in crop acreage data file)
C              * Enter 0 if full time series data is supplied
C              * Enter any number if time-tracking option is on
C   DSSFL ;   The name of the DSS file for data input (maximum 50 characters);
C              * Leave blank if DSS file is not used for data input
C
C-----------------------------------------------------------------------------------------
C   VALUE                      DESCRIPTION
C-----------------------------------------------------------------------------------------
    43560.0                    / FACTLN
    1                          / NSPLN
    0                          / NFQLN
    TSDATA_IN.DSS              / DSSFL
C-----------------------------------------------------------------------------------------
C                             Land Use Data
C                          (READ FROM THIS FILE)
C
C   List the land use data below, if it will not be read from a DSS file
C   (i.e. DSSFL is left blank above).
C
C   ITLN ;   Time
C   IE   ;   Element number
C   ALAND;   Area (or fraction of area) corresponding to each land use type
C             over an element; [L^2] or [L/L]
C
C-----------------------------------------------------------------------------------------
C                                              ALAND
C                    ------------------------------------------------------------------
C   ITLN    IE       Agricultural    Urban      Native veg.     Riparian veg.
C-----------------------------------------------------------------------------------------
*
*
C-----------------------------------------------------------------------------------------
C                              Pathnames for Land Use Data
C                                (READ FROM DSS FILE)
C
C   List the pathnames for the land use data below, if it will be read from a DSS file
C   (i.e. DSSFL is specified above).
C
C   The pathnames should be listed for each element and land use type combination.
C   They should be listed in an order such that, the land use type changes first.
C
C   * Example:
C
C       IE     LUTYPE      PATH
C        1        1       (pathname[1])
C        1        2       (pathname[2])
C        1        3       (pathname[3])
C        1        4       (pathname[4])
C        2        1       (pathname[5])
C        2        2       (pathname[6])
C        2        3       (pathname[7])
C        2        4       (pathname[8])
C        .        .            .
C        .        .            .
C        .        .            .
C       NE        1       (pathname[(4*NE)-3])
C       NE        2       (pathname[(4*NE)-2])
C       NE        3       (pathname[(4*NE)-1])
```

```
C       NE        4       (pathname[(4*NE)  ])
C
C   IE     ;  Element number
C   LUTYPE ;  Land use type
C               1 = Agricultural
C               2 = Urban
C               3 = Native vegetation
C               4 = Riparian vegetation
C   PATH   ;  Pathname corresponding to element and land use type combination
C
C-----------------------------------------------------------------------------
C   IE        LUTYPE        PATH
C-----------------------------------------------------------------------------
    1         1             /IWFM/E1_AG/AREA//1YEAR/LAND_USE/
    1         2             /IWFM/E1_UR/AREA//1YEAR/LAND_USE/
    1         3             /IWFM/E1_NV/AREA//1YEAR/LAND_USE/
    1         4             /IWFM/E1_RV/AREA//1YEAR/LAND_USE/
    2         1             /IWFM/E2_AG/AREA//1YEAR/LAND_USE/
    2         2             /IWFM/E2_UR/AREA//1YEAR/LAND_USE/
    2         3             /IWFM/E2_NV/AREA//1YEAR/LAND_USE/
    2         4             /IWFM/E2_RV/AREA//1YEAR/LAND_USE/
    .         .                       .
    .         .                       .
    .         .                       .
    400       1             /IWFM/E400_AG/AREA//1YEAR/LAND_USE/
    400       2             /IWFM/E400_UR/AREA//1YEAR/LAND_USE/
    400       3             /IWFM/E400_NV/AREA//1YEAR/LAND_USE/
    400       4             /IWFM/E400_RV/AREA//1YEAR/LAND_USE/
```

Crop Acreage Data File Unit 14

This file contains the time series subregional acreages for all crops modeled as well as non-agricultural land use types in the modeled area. This includes urban, native, and riparian areas which are the last three listed for each time step. The sum of all crop and non-agricultural land use type areas given for a subregion should equal the subregional area specified in the model. For each time step specified, all subregional crop and non-agricultural areas are specified. In non-time tracking simulations the time series data set can be comprised of any frequency, as long as the correct time step controls are set (NSPCR and NFQCR) and they correspond to the time step controls set in Unit 13. In time tracking simulations the time series crop acreage data can be either listed in this file or in a DSS file. If a DSS file is used for data input, then the name of the DSS file and the pathnames corresponding to each of the time series data are required.

The following terms and descriptions encompass the data input to Unit 14:

NCOLCR	Total number of crops and non-agricultural land use types modeled
FACTCR	Factor to convert crop area to simulation unit of area
NSPCR	Number of time steps to update the subregional acreage data; NSPCR must equal the value specified for NSPLN in Unit 13. If time tracking simulation, enter any number.
NFQCR	Repetition frequency of the subregional acreage data; NFQCR must equal NFQLN specified in Unit 13. NFQLN is set to zero when this file includes a time-series data defined for the entire simulation period. If time tracking simulation, enter any number.

DSSFL — If the time series data is stored in a DSS file, name of the file. Leave blank if the data is listed in the ASCII text file.

Data Input from ASCII Text File

If the time series data is listed in the same ASCII text file, then the following variables need to be populated. Otherwise, these variables should be commented out using "C", "c" or "*", and the variables in the "Data Input from DSS File" section below should be populated.

ITCR — Time. For time tracking simulations use MM/DD/YYYY_hh:mm format, for non-time tracking simulations enter an integer number.

IR — Subregion identification number

ACROP — Area of crop and land use types within each subregion, [L^2]

Data Input from DSS File

If time series data is stored in a DSS file then the following variables should be populated. The subregion and the crop/land use type identification numbers should be entered sequentially such that the crop/land use type changes first. For a particular subregion the time series data pathnames for agricultural crops are entered first, followed by the pathnames for the urban, native vegetation and riparian vegetation lands.

IR — Subregion identification number

CRTYPE — Crop/land use type identification number

PATH — Pathname for the time series data for the corresponding subregion and crop/land use type combination

```
C*******************************************************************************
C
C               INTEGRATED WATER FLOW MODEL (IWFM)
C                      *** Version ### ***
C
C*******************************************************************************
C
C                  CROP ACREAGE DATA FILE
C                   for IWFM Simulation
C                        (Unit 14)
C
C
C             Project :  IWFM Version ### Release
C                        California Department of Water Resources
C             Filename:  CROPAREA.DAT
C
C*******************************************************************************
C                        File Description:
C
C   This data file contains the time-series crop acreage data for each sub-region.
C
C*******************************************************************************
C                        Crop Acreage Data Specifications
C
C   NCOLCR;  Total number of crop and non-agricultural land use types (or pathnames
C             if DSS files are used)
C   FACTCR;  Conversion factor for crop area
C   NSPCR ;  Number of time steps to update the crop acreage data
C             (Note: This value should be equal to NSPLN in land use data file)
C             * Enter any number if time-tracking option is on
C   NFQCR ;  Repetition frequency of the crop acreage data
C             (Note: This value should be equal to NFQLN in land use data file)
C             * Enter 0 if full time series data is supplied
C             * Enter any number if time-tracking option is on
C   DSSFL ;  The name of the DSS file for data input (maximum 50 characters);
C             * Leave blank if DSS file is not used for data input
C
C-------------------------------------------------------------------------------
C   VALUE                       DESCRIPTION
C-------------------------------------------------------------------------------
    5                           / NCOLCR
    43560.0                     / FACTCR
    1                           / NSPCR
    0                           / NFQCR
                                / DSSFL
C-------------------------------------------------------------------------------
C                          Crop Acreage Data
C                         (READ FROM THIS FILE)
C
C   List the acreage for each crop and non-agricultural land use type for each
C   sub-region below, if it will not be read from a DSS file (i.e. DSSFL is
C   left blank above).
C
C   ITCR ;   Time of crop survey
C   IR   ;   Subregion number
C   ACROP;   Acreage of crop or land use type in corresponding sub-region; [L^2]
C
*
*   Crop/Land Use No.           Name
*   ----------------            ------
*         1                PA = PASTURE
*         2                AL = ALFALFA
*         3                UR = URBAN
*         4                NV = NATIVE VEGETATION
*         5                RV = RIPARIAN VEGETATION
C-------------------------------------------------------------------------------
C ITCR              IR   ACROP(1)  ACROP(2)  ACROP(3)   ACROP(4)    ACROP(5)
C-------------------------------------------------------------------------------
 09/30/1982_24:00     1     11704       405     28661    281134        0
                      2     41600      9100     17917    515377        0
 09/30/1983_24:00     1     11514       405     32475    278632        0
                      2     42500      8600     18147    524047        0
 09/30/1984_24:00     1     11362       405     36290    274269        0
                      2     43400      8100     18378    510616        0
         .            .        .         .         .         .         .
         .            .        .         .         .         .         .
         .            .        .         .         .         .         .
 09/30/2002_24:00     1     24100      1000     74328    223187        0
                      2     34600      7100     27074    503120        0
 09/30/2003_24:00     1     24000       700     74821    222593        0
                      2     34800      7200     27660    502133        0
C-------------------------------------------------------------------------------
C                    Pathnames for Crop Acreage Data
C                         (READ FROM DSS FILE)
C
C   List the pathnames for the crop acreage data below, if it will be read
C   from a DSS file (i.e. DSSFL is specified above).
C
C   The pathnames should be listed for each sub-region, crop/non-agricultural
C   land use type combination.  They should be listed in an order such that the
```

```
C   crop/land use type changes first.
C
C   * Example [simulation includes 3 agricultural crops; total of 6 crop and
C              non-agricultural land use types]:
C
C       IR     CRTYPE      PATH
C        1        1       (pathname[1])             => Sub-region 1; crop 1
C        1        2       (pathname[2])             => Sub-region 1; crop 2
C        1        3       (pathname[3])             => Sub-region 1; crop 3
C        1        4       (pathname[4])             => Sub-region 1; urban land
C        1        5       (pathname[5])             => Sub-region 1; native veg.
C        1        6       (pathname[6])             => Sub-region 1; riparian veg.
C        2        1       (pathname[7])             => Sub-region 2; crop 1
C        2        2       (pathname[8])             => Sub-region 2; crop 2
C        2        3       (pathname[9])             => Sub-region 2; crop 3
C        2        4       (pathname[10])            => Sub-region 2; urban land
C        2        5       (pathname[11])            => Sub-region 2; native veg.
C        2        6       (pathname[12])            => Sub-region 2; riparian veg.
C        .        .            .
C        .        .            .
C        .        .            .
C       NREGN     1       (pathname[(6*NREGN)-5])   => Sub-region NREGN; crop 1
C       NREGN     2       (pathname[(6*NREGN)-4])   => Sub-region NREGN; crop 2
C       NREGN     3       (pathname[(6*NREGN)-3])   => Sub-region NREGN; crop 3
C       NREGN     4       (pathname[(6*NREGN)-2])   => Sub-region NREGN; urban land
C       NREGN     5       (pathname[(6*NREGN)-1])   => Sub-region NREGN; native veg.
C       NREGN     6       (pathname[(6*NREGN)  ])   => Sub-region NREGN; riparian veg.
C
C   IR     ;  Subregion number
C   CRTYPE ;  Crop/non-agricultural land use type
C   PATH   ;  Pathname corresponding to sub-region and crop/non-agricultural land use type combination
C
C-----------------------------------------------------------------------------------------------------
C   IR        CRTYPE        PATH
C-----------------------------------------------------------------------------------------------------
*
*
```

Precipitation File — Unit 15

This file contains the time series rainfall values for each of the rainfall stations used in the simulation. Each element is associated with a rainfall station. The factors that convert the precipitation at rainfall stations to the precipitation over the elements are listed in the element characteristic input file in pre-processor. The rainfall data for a station associated with an element is multiplied by the factor defined in the pre-processor to obtain the rainfall rate over an element.

In non-time tracking simulations a time-series precipitation data set of any frequency can be used as the precipitation data in IWFM. NSPRN and NFQRN must be specified according to the frequency of the data entered. If the precipitation data is specified for the entire simulation period, NFQRN should be set to zero. In time tracking simulations the time series precipitation data can be either listed in this file or in a DSS file. If a DSS file is used for data input, then the name of the DSS file and the pathnames corresponding to each of the time series data are required.

The following variables are used:

NRAIN	Number of rainfall stations used in the model
FACTRN	Conversion factor for the spatial component of the unit for the rainfall rate
NSPRN	Number of time steps to update the precipitation data. If time tracking simulation, enter any number.
NFQRN	Repetition frequency of the precipitation data (enter zero if full time series data is supplied). If time tracking simulation, enter any number.

DSSFL If the time series data is stored in a DSS file, name of the file. Leave blank if the data is listed in the ASCII text file.

Data Input from ASCII Text File

If the time series data is listed in the same ASCII text file, then the following variables need to be populated. Otherwise, these variables should be commented out using "C", "c" or "*", and the variables in the "Data Input from DSS File" section below should be populated.

ITRN Time. For time tracking simulations use MM/DD/YYYY_hh:mm format, for non-time tracking simulations enter an integer number.

ARAIN Rainfall rate at the corresponding rainfall station, [L/T]

Data Input from DSS File

If time series data is stored in a DSS file then the following variables should be populated:

REC Record number that coincides with the data column number for the time series data

PATH Pathname for the time series record that will be used for data retrieval

```
C*******************************************************************************
C
C               INTEGRATED WATER FLOW MODEL (IWFM)
C                      *** Version ### ***
C
C*******************************************************************************
C
C                  PRECIPITATION DATA FILE
C                    for IWFM Simulation
C                        (Unit 15)
C
C
C             Project :  IWFM Version ### Release
C                        California Department of Water Resources
C             Filename:  PRECIP.DAT
C
C*******************************************************************************
C                             File Description:
C
C   This data file contains the time-series rainfall at each rainfall station used
C   in the model.
C
C*******************************************************************************
C                         Rainfall Data Specifications
C
C   NRAIN ;  Number of rainfall stations (or pathnames if DSS files are used)
C             used in the model
C   FACTRN;  Conversion factor for rainfall rate
C             It is used to convert only the spatial component of the unit;
C             DO NOT include the conversion factor for time component of the unit.
C             * e.g. Unit of rainfall rate listed in this file = INCHES/MONTH
C                    Consistent unit used in simulation        = FEET/DAY
C                    Enter FACTRN (INCHES/MONTH -> FEET/MONTH) = 8.33333E-02
C                     (conversion of MONTH -> DAY is performed automatically)
C   NSPRN ;  Number of time steps to update the precipitation data
C             * Enter any number if time-tracking option is on
C   NFQRN ;  Repetition frequency of the precipitation data
C             * Enter 0 if full time series data is supplied
C             * Enter any number if time-tracking option is on
C   DSSFL ;  The name of the DSS file for data input (maximum 50 characters);
C             * Leave blank if DSS file is not used for data input
C
C-------------------------------------------------------------------------------
C   VALUE                       DESCRIPTION
C-------------------------------------------------------------------------------
    2                           / NRAIN
    0.0027778                   / FACTRN
    1                           / NSPRN
    1                           / NFQRN
                                / DSSFL
C-------------------------------------------------------------------------------
C                             Rainfall Data
C                         (READ FROM THIS FILE)
C
C   List the rainfall rates for each of the rainfall station below, if it will
C   not be read from a DSS file (i.e. DSSFL is left blank above).
C
C   ITRN ;   Time
C   ARAIN;   Rainfall rate at the corresponding rainfall station; [L/T]
C
C-------------------------------------------------------------------------------
C      ITRN          ARAIN(1)  ARAIN(2)
C-------------------------------------------------------------------------------
  01/31/1995_24:00      22.93   21.47
  02/28/1995_24:00      1.65    0.90
  03/31/1995_24:00      14.78   10.23
         .              .       .
         .              .       .
         .              .       .
  11/30/2005_24:00      4.84    5.07
  12/31/2005_24:00      13.90   7.67
C-------------------------------------------------------------------------------
C                       Pathnames for Rainfall Data
C                         (READ FROM DSS FILE)
C
C   List the pathnames for the rainfall data below, if it will be read
C   from a DSS file (i.e. DSSFL is specified above).
C
C   REC    ;  Time series record number
C   PATH   ;  Pathname for the time series record
C
C----------------------------------------------------------------------------------
C   REC        PATH
C----------------------------------------------------------------------------------
*
*
```

Evapotranspiration File Unit 16

The evapotranspiration data file contains time series ET_c data for all crop types, non-agricultural land use types and bare soil evaporation under standard conditions for each subregion. The ET_c rates should be entered in the following order: agricultural crop types in the order listed in the parameter data file (Unit 7), urban, native vegetation, riparian vegetation and bare soil evaporation. This is followed by ET_c and soil evaporation for each small stream watershed group specified in the parameter data file (Unit 7). The conversion factor for the ET_c rates is a required input, as well as the number of time steps to update the data and the repetition frequency of the data. In time tracking simulations the time series evapotranspiration data can be either listed in this file or in a DSS file. If a DSS file is used for data input, then the name of the DSS file and the pathnames corresponding to each of the time series data are required. The example file given below shows how recycled time series data in a time tracking simulation can be specified.

The following a list of the variables that need to be specified:

NEVAP	Number of crop and land use types
FACTET	Conversion factor for the spatial component of the unit for the evapotranspiration rate
NSPET	Number of time steps to update the ET data. If time tracking simulation, enter any number.
NFQET	Repetition frequency of the ET data (enter zero if full time series data is supplied). If time tracking simulation, enter any number.

DSSFL — If the time series data is stored in a DSS file, name of the file. Leave blank if the data is listed in the ASCII text file.

Data Input from ASCII Text File

If the time series data is listed in the same ASCII text file, then the following variables need to be populated. Otherwise, these variables should be commented out using “C”, “c” or “*”, and the variables in the “Data Input from DSS File” section below should be populated.

ITEV — Time. For time tracking simulations use MM/DD/YYYY_hh:mm format, for non-time tracking simulations enter an integer number.

IREGN — Subregion number

AEVAP — Evapotranspiration rate for all crop types, non-agricultural land use types and bare soil evaporation under standard conditions in a subregion, [L/T]. After listing ET rates for each subregion, the ET_c rates for native vegetation and soil evaporation for each small watershed group should also be listed

Data Input from DSS File

If time series data is stored in a DSS file then the following variables should be populated. The subregion and the crop/land use type identification numbers should be entered sequentially such that the crop/land use type changes first. For a particular subregion the time series data pathnames for agricultural crops are entered first, followed by the pathnames for the urban, native vegetation and riparian vegetation lands. Finally, the data for native vegetation and bare soil for each small watershed should be entered.

IR	Subregion identification number
CRTYPE	Crop/land use type identification number
PATH	Pathname for the time series data for the corresponding subregion/small watershed and crop/land use type combination

```
C*******************************************************************************
C
C                   INTEGRATED WATER FLOW MODEL (IWFM)
C                          *** Version ### ***
C
C*******************************************************************************
C
C                     EVAPOTRANSPIRATION DATA FILE
C                         for IWFM Simulation
C                              (Unit 16)
C
C
C            Project :  IWFM Version ### Release
C                       California Department of Water Resources
C            Filename:  ET.DAT
C
C*******************************************************************************
C                          File Description:
C
C   This data file contains the crop evapotranspiration values under standard
C   conditions (ETc) for each sub-region for each crop and non-agricultural land
C   use type. Evapotranspiration rate of native vegetation and soil at small stream
C   watersheds are also listed in this file.
C
C*******************************************************************************
C                      Evapotranspiration Data Specifications
C
C   NEVAP ;  Number of crop and land use types (or pathnames if DSS files are used)
C   FACTET:  Conversion factor for evapotranspiration rate
C             It is used to convert only the spatial component of the unit;
C             DO NOT include the conversion factor for time component of the unit.
C             * e.g. Unit of ET rate listed in this file       = INCHES/MONTH
C                    Consistent unit used in simulation        = FEET/DAY
C                    Enter FACTET (INCHES/MONTH -> FEET/MONTH) = 8.33333E-02
C                     (conversion of MONTH -> DAY is performed automatically)
C   NSPET ;  Number of time steps to update the ET data
C               * Enter any number if time-tracking option is on
C   NFQET ;  Repetition frequency of the ET data
C               * Enter 0 if full time series data is supplied
C               * Enter any number if time-tracking option is on
C   DSSFL ;  The name of the DSS file for data input (maximum 50 characters);
C               * Leave blank if DSS file is not used for data input
C
C-------------------------------------------------------------------------------
C   VALUE                         DESCRIPTION
C-------------------------------------------------------------------------------
    6                             / NEVAP
    0.00277778                    / FACTET
    1                             / NSPET
    1                             / NFQET
                                  / DSSFL
C-------------------------------------------------------------------------------
C                                Evapotranspiration Data
C                                 (READ FROM THIS FILE)
C
C   List the ETc rate for each crop, non-agricultural land use, and soil for each
C   sub-region, followed by the ETc rate for native vegetation and soil for small
C   stream watersheds, if it will not be read from a DSS file (i.e. DSSFL is left
C   blank above).
C
C   ITEV ;   Time
C   IREGN;   Subregion number
C   AEVAP;   Evapotranspiration rate for corresponding land use and sub-region; [L/T]
C             (Include ETc rates for all crop types, non-agricultural land use types and
C              soil evaporation. After listing ETc values for each subregion, list the values
C              for native vegetation and soil evaporation for small stream watersheds.)
C
C-------------------------------------------------------------------------------
C ITEV           IREGN  AEVAP(1)  AEVAP(2)  AEVAP(3) ...
C-------------------------------------------------------------------------------
01/31/4000_24:00    1      1.0     1.0     0.0    1.4    0.0    1.0
                    2      1.0     1.0     1.0    1.4    1.0    1.0
                    3      1.0     1.0     1.0    1.4    1.0    1.0
                    1      0.0     1.1
                    2      0.0     1.1
02/29/4000_24:00    1      1.8     1.8     0.0    1.8    0.0    1.8
                    2      1.8     1.8     1.8    1.8    1.8    1.8
                    3      1.8     1.8     1.8    1.8    1.8    1.8
                    1      0.0     1.8
                    2      0.0     1.8
       .            .      .       .       .      .      .      .
                    .      .       .       .      .      .      .
                    .      .       .       .      .      .      .
                    .      .       .       .      .      .      .
       .            .      .       .       .      .      .      .
                    .      .       .       .      .      .      .
                    .      .       .       .      .      .      .
                    .      .       .       .      .      .      .
11/30/4000_24:00    1      1.6     1.6     0.0    1.6    0.0    1.6
                    2      1.6     1.6     1.6    1.6    1.6    1.6
                    3      1.6     1.6     1.6    1.5    1.5    1.5
                    1      1.6     1.8
                    2      1.6     1.8
12/31/4000_24:00    1      1.0     1.0     0.0    1.0    0.0    1.0
                    2      1.0     1.0     1.0    1.0    1.0    1.0
                    3      1.0     1.0     1.0    1.0    1.0    1.0
                    1      0.0     1.2
                    2      0.0     1.2
```

```
C-------------------------------------------------------------------------------
C                        Pathnames for Evapotranspiration Data
C                               (READ FROM DSS FILE)
C
C   List the pathnames for ETc rates for each crop, non-agricultural land use, and
C   soil for each sub-region, followed by the ETc rate for native vegetation and
C   soil for small stream watersheds, if it will be read from a DSS file (i.e. DSSFL
C   is specified above).
C
C   The pathnames should be listed for each subregion and crop/land use type combination,
C   as well as for each small watershed and native veg./soil combination.  Use the
C   following example for the order of pathnames.
C
C   * Example [simulation includes 3 agricultural crops and 2 small watersheds]
C
C       IR     CRTYPE     PATH
C        1       1        (pathname[1])              => Sub-region 1; crop 1
C        1       2        (pathname[2])              => Sub-region 1; crop 2
C        1       3        (pathname[3])              => Sub-region 1; crop 3
C        1       4        (pathname[4])              => Sub-region 1; urban land
C        1       5        (pathname[5])              => Sub-region 1; native veg.
C        1       6        (pathname[6])              => Sub-region 1; riparian veg.
C        1       7        (pathname[7])              => Sub-region 1; bare soil
C        2       1        (pathname[8])              => Sub-region 2; crop 1
C        2       2        (pathname[9])              => Sub-region 2; crop 2
C        2       3        (pathname[10])             => Sub-region 2; crop 3
C        2       4        (pathname[11])             => Sub-region 2; urban land
C        2       5        (pathname[12])             => Sub-region 2; native veg.
C        2       6        (pathname[13])             => Sub-region 2; riparian veg.
C        2       7        (pathname[14])             => Sub-region 2; bare soil
C        .       .             .
C        .       .             .
C        .       .             .
C      NREGN     1        (pathname[(7*NREGN)-6])    => Sub-region NREGN; crop 1
C      NREGN     2        (pathname[(7*NREGN)-5]])   => Sub-region NREGN; crop 2
C      NREGN     3        (pathname[(7*NREGN)-4]])   => Sub-region NREGN; crop 3
C      NREGN     4        (pathname[(7*NREGN)-3]])   => Sub-region NREGN; urban land
C      NREGN     5        (pathname[(7*NREGN)-2]])   => Sub-region NREGN; native veg.
C      NREGN     6        (pathname[(7*NREGN)-1]])   => Sub-region NREGN; riparian veg.
C      NREGN     7        (pathname[(7*NREGN)  ])    => Sub-region NREGN; bare soil
C        1       1        (pathname[(7*NREGN)+1])    => Small watershed 1; native vegitation
C        1       2        (pathname[(7*NREGN)+2]])   => Small watershed 1; bare soil
C        2       1        (pathname[(7*NREGN)+3]])   => Small watershed 2; native vegitation
C        2       2        (pathname[(7*NREGN)+4]])   => Small watershed 2; bare soil
C
C   IR     ;  Subregion (or small watershed number
C   CRTYPE ;  Crop, non-agricultural land use or bare soil identifier
C   PATH   ;  Pathname for the time series record
C
C-----------------------------------------------------------------------------------------------
C   IR        CRTYPE        PATH
C-----------------------------------------------------------------------------------------------
*
*
```

Tile Drain Parameter File Unit 17

This data file includes all the required input to model tile drains or subsurface irrigation in IWFM. The start of the data file lists the number of groundwater nodes with tile drains or subsurface irrigation, and conversion factors for tile drain (or subsurface irrigation) elevations and conductance. Next, the actual table describing the tile drains or subsurface irrigation is listed. For each node specified for tile drainage/subsurface irrigation modeling, the elevation of the drain, conductance and stream node the drain flows into are required. If the tile drain flows leave the modeled area, the stream node should be set to zero.

To distinguish tile drains from subsurface irrigation, groundwater node numbers with tile drains are listed as negative values, whereas nodes with subsurface irrigation are listed as positive values. For example:

GW node = 543	GW node = 2004
Tile drain ID = –543	Tile drain ID = –2004

For subsurface irrigation:

GW node = 543	GW node = 2004
Subsurface irrigation ID = 543	Subsurface irrigation ID = 2004

The following list includes all required input to simulate tile drain flows in IWFM:

NTD	Number of groundwater nodes with tile drains/subsurface irrigation
FACTH	Conversion factor for tile drain/subsurface irrigation elevations

FACTCDC	Conversion factor for the spatial component of the unit for the tile drain/subsurface irrigation conductance
TUNIT	Time unit of conductance. This should be one of the units recognized by HEC-DSS that are listed in the Main Control File.
NODEDR	Node number corresponding to the tile drain (listed as a negative number) or subsurface irrigation (listed as positive number)
ELEVDR	Elevation of the tile drain/subsurface irrigation, [L]
CDCDR	Hydraulic conductance of the interface between the aquifer and the tile drain/subsurface irrigation, [L^2/T]
ISTRMDR	Stream node into which drain flows into; 0 if the drain flows leave the modeled area

```
C*******************************************************************************
C
C                   INTEGRATED WATER FLOW MODEL (IWFM)
C                          *** Version ### ***
C
C*******************************************************************************
C
C                   TILE DRAINS PARAMETER DATA FILE
C                         for IWFM Simulation
C                             (Unit 17)
C
C
C              Project :  IWFM Version ### Release
C                         California Department of Water Resources
C              Filename:  TILEDRN.DAT
C
C*******************************************************************************
C                           File Description:
C
C   This data file contains tile drains parameter values.
C
C*******************************************************************************
C               Tile Drains Data Specifications
C
C   NTD    ;  Number of groundwater nodes with tile drains
C   FACTH  ;  Conversion factor for tile drain elevations
C   FACTCDC;  Conversion factor for tile drain conductances
C             It is used to convert only the spatial component of the unit;
C             DO NOT include the conversion factor for time component of the unit.
C             * e.g. Unit of conductance listed in this file = AC/MONTH
C                    Consistent unit used in simulation      = SQ.FT/DAY
C                    Enter FACTQ (AC/MONTH -> SQ.FT/MONTH)   = 2.29568E-05
C                     (conversion of MONTH -> DAY is performed automatically)
C   TUNIT ; Time unit of conductance.  This should be one of the units
C             recognized by HEC-DSS that are listed in the Main Control File.
C-------------------------------------------------------------------------------
C       VALUE                   DESCRIPTION
C-------------------------------------------------------------------------------
        21                      / NTD
        1.0                     / FACTH
        4.0                     / FACTCDC
        1mon                    / TUNIT
C-------------------------------------------------------------------------------
C                         Tile Drain Parameters
C
C   The following lists the groundwater node number, elevation and conductance
C   for each tile drain. The stream node that the tile drain flow contributes to
C   is also listed.
C
C   NODEDR ; Groundwater node number corresponding to the tile drain
C        Case 1: For drainage out of node, list the node number as a negative value. For example,
C          list node 898 as -898,
C          list node 98 as -98,
C          list node 1898 as -1898
C        Case 2: For drainage into the node, list the node number as a positive value. For example,
C          list node 898 as 898,
C          list node 98 as 98,
C          list node 1898 as 1898
C   ELEVDR ; Elevation of the drain; [L]
C   CDCDR  ; Hydraulic conductance of the interface between the aquifer and
C              the drain; [L^2/T]
C   ISTRMDR; Stream node into which drain flows into (input 0 (zero) if the
C              drain flows out of the modeled area)
C
C-------------------------------------------------------------------------------
C   NODEDR    ELEVDR         CDCDR         ISTRMDR
C-------------------------------------------------------------------------------
     -6       280.0          5000.0         20
     -27      280.0          5000.0         20
     -48      280.0          5000.0         20
     -69      280.0          5000.0         20
     -90      280.0          5000.0         20
     -111     280.0          5000.0         20
     -132     280.0          5000.0         20
     -153     280.0          5000.0         20
     -174     280.0          5000.0         20
     -195     280.0          5000.0         20
     -216     280.0          5000.0         20
     -237     280.0          5000.0         20
     -258     280.0          5000.0         20
     -279     280.0          5000.0         20
     -300     280.0          5000.0         20
     -321     280.0          5000.0         20
     -342     280.0          5000.0         20
     -363     280.0          5000.0         20
     -384     280.0          5000.0         20
     -405     280.0          5000.0         20
     -426     280.0          5000.0         20
```

Urban Water Use Specification File Unit 18

The urban water use file lists the fraction of water supplied to urban areas to be used indoors for each subregion. In time tracking simulations the time series urban water use specification data can be either listed in this file or in a DSS file. If a DSS file is used for data input, then the name of the DSS file and the pathnames corresponding to each of the time series data are required. The following is a list of the variables used in this file:

NSPURBSP	Number of time steps to update the urban water use specification data. If time tracking simulation, enter any number.
NFQURBSP	Repetition frequency of the urban water use specification data (enter zero if full time series data is supplied). If time tracking simulation, enter any number.
DSSFL	If the time series data is stored in a DSS file, name of the file. Leave blank if the data is listed in the ASCII text file.

Data Input from ASCII Text File

If the time series data is listed in the same ASCII text file, then the following variables need to be populated. Otherwise, these variables should be commented out using “C”, “c” or “*”, and the variables in the “Data Input from DSS File” section below should be populated.

ITUSP	Time. For time tracking simulations use MM/DD/YYYY_hh:mm format, for non-time tracking simulations enter an integer number.
IR	Subregion number

URINDR Fraction of total urban water that is specified for urban indoor water use

Data Input from DSS File

If time series data is stored in a DSS file then the following variables should be populated:

IR Subregion identification number

PATH Pathname for the time series record that will be used for data retrieval

```
C*******************************************************************************
C
C                   INTEGRATED WATER FLOW MODEL (IWFM)
C                          *** Version ### ***
C
C*******************************************************************************
C
C                   URBAN WATER USAGE SPECIFICATION DATA FILE
C                            for IWFM Simulation
C                                (Unit 18)
C
C
C              Project :  IWFM Version ### Release
C                         California Department of Water Resources
C              Filename:  URBSPEC.DAT
C
C*******************************************************************************
C                               File Description
C
C   This data file contains the urban water usage specification data. The
C   fraction of total urban water that is used indoors for each subregion
C   is listed.
C
C*******************************************************************************
C                             Urban Water Use Data Specifications
C
C   NSPURBSP;   Number of time steps to update the urban water use specification data
C                 * Enter any number if time-tracking option is on
C   NFQURBSP;   Repitition frequency of the urban water use sepcification data
C                 * Enter 0 if full time series data is supplied
C                 * Enter any number if time-tracking option is on
C   DSSFL   ;   The name of the DSS file for data input (maximum 50 characters);
C                 * Leave blank if DSS file is not used for data input
C
C------------------------------------------------------------------------------
C    VALUE                        DESCRIPTION
C------------------------------------------------------------------------------
     1                            / NSPURBSP
     1                            / NFQURBSP
                                  / DSSFL
C-----------------------------------------------------------------------------------------------
C                             Urban Water Use Data
C                             (READ FROM THIS FILE)
C
C   List the urban water use data below, if it will not be read from
C   a DSS file (i.e. DSSFL is left blank above).
C
C   ITUSP ;  Time
C   IR    ;  Subregion number
C   URINDR;  Fraction of total urban water that is used indoors
C
C-----------------------------------------------------------------------------------------------
C   ITUSP              IR    URINDR
C-----------------------------------------------------------------------------------------------
  01/31/4000_24:00      1      1.0
                        2      1.0
  02/29/4000_24:00      1      1.0
                        2      1.0
  03/31/4000_24:00      1      0.6
                        2      0.6
        .               .       .
        .               .       .
        .               .       .
  11/30/4000_24:00      1      0.7
                        2      0.7
  12/31/4000_24:00      1      0.8
                        2      0.8
C------------------------------------------------------------------------------
C                        Pathnames for Urban Water Use Data
C                              (READ FROM DSS FILE)
C
C   List the pathnames for urban water use data below, if it will be read
C   from a DSS file (i.e. DSSFL is specified above).
C
C   IR   ;  Sub-region number
C   PATH ;  Pathname for the time series record
C
C-------------------------------------------------------------------------------------------------
C   IR       PATH
C-------------------------------------------------------------------------------------------------
*
*
```

Agricultural Water Supply Requirement File   Unit 19

This data file contains the water demand for the agricultural crops. The model requires that either this input file or Unit 22 is specified to simulate agricultural demand. Specifying this KOPTDM as zero in Unit 5 prompts the model to specify agricultural demand as seen in this file. For each time series data entry, the total agricultural demand must be specified for each subregion. A conversion factor that converts listed data to the simulation unit of volumetric flow rate is a required input, as well as the number of time steps to update the demand data and the repetition frequency of the data file. In time tracking simulations the time series agricultural water supply requirement data can be either listed in this file or in a DSS file. If a DSS file is used for data input, then the name of the DSS file and the pathnames corresponding to each of the time series data are required. The input included in Unit 19 is listed below:

FACTDAGF	Factor to convert the spatial component of the unit for the agricultural demand
NSPDAGF	Number of time steps to update the agricultural demand data. If time tracking simulation, enter any number.
NFQDAGF	Repetition frequency of the agricultural demand data (enter zero if full time series data is supplied). If time tracking simulation, enter any number.
DSSFL	If the time series data is stored in a DSS file, name of the file. Leave blank if the data is listed in the ASCII text file.

Data Input from ASCII Text File

If the time series data is listed in the same ASCII text file, then the following variables need to be populated. Otherwise, these variables should be commented out using "C", "c" or "*", and the variables in the "Data Input from DSS File" section below should be populated.

ITDA	Time. For time tracking simulations use MM/DD/YYYY_hh:mm format, for non-time tracking simulations enter an integer number.
RDMAG	Subregional agricultural water demand, [L^3/T]

Data Input from DSS File

If time series data is stored in a DSS file then the following variables should be populated:

IR	Subregion identification number
PATH	Pathname for the time series record that will be used for data retrieval

```
C*******************************************************************************
C
C                   INTEGRATED WATER FLOW MODEL (IWFM)
C                          *** Version ### ***
C
C*******************************************************************************
C
C           AGRICULTURAL WATER SUPPLY REQUIREMENT DATA FILE
C                      for IWFM Simulation
C                          (Unit 19)
C
C
C              Project :  IWFM Version ### Release
C                         California Department of Water Resources
C              Filename:  AGDEMAND.DAT
C
C*******************************************************************************
C                            File Description
C
C    This data file contains the agricultural water demand for
C    each sub-region for the model simulation period. This file
C    is required only if KOPTDM in the main control file (Unit 5)
C    is set to zero.
C
C*******************************************************************************
C              Agricultural Water Supply Requirement Data Specifications
C
C    FACTDAGF;  Conversion factor for the agricultural supply requirement
C                It is used to convert only the spatial component of the unit;
C                DO NOT include the conversion factor for time component of the unit.
C                * e.g. Unit of flow listed in this file          = AC-FT/MONTH
C                       Consistent unit used in simulation        = CU.FT/DAY
C                       Enter FACTDAGF (AC-FT/MONTH -> CU.FT/MONTH)= 2.29568E-05
C                      (conversion of MONTH -> DAY is performed automatically)
C    NSPDAGF ;  Number of time steps to update the agricultural supply requirement data
C                * Enter any number if time-tracking option is on
C    NFQDAGF ;  Repetition frequency of the agricultural supply requirement data
C                * Enter 0 if full time series data is supplied
C                * Enter any number if time-tracking option is on
C    DSSFL   ;  The name of the DSS file for data input (maximum 50 characters);
C                * Leave blank if DSS file is not used for data input
C
C-----------------------------------------------------------------------------
C    VALUE                        DESCRIPTION
C-----------------------------------------------------------------------------
     43560000.0                   / FACTDAGF
     1                            / NSPDAGF
     0                            / NFQDAGF
     TSDATA_IN.DSS                / DSSFL
C-----------------------------------------------------------------------------
C                Agricultural Water Supply Requirement Data
C                          (READ FROM THIS FILE)
C
C    List the agricultural water supply requirement data below, if it will not
C    be read from a DSS file (i.e. DSSFL is left blank above).
C
C    ITDA;    Time
C    RDMAG;   Sub-regional agricultural water supply requirement; [L^3/T]
C
C-----------------------------------------------------------------------------
C ITDA     RDMAG(1)  RDMAG(2)  RDMAG(3) ...
C-----------------------------------------------------------------------------
*
*
C------------------------------------------------------------------------------
C                   Pathnames for Agricultural Water Supply Requirement Data
C                                 (READ FROM DSS FILE)
C
C    List the pathnames for the agricultural water supply requirement data below,
C    if it will be read from a DSS file (i.e. DSSFL is specified above).
C
C    IR   ;  Sub-region number
C    PATH ;  Pathname for the time series record
C
C-------------------------------------------------------------------------------------
C    IR       PATH
C-------------------------------------------------------------------------------------
     1        /IWFM/SR1/FLOW//1MON/AG_SUPP_REQ/
     2        /IWFM/SR2/FLOW//1MON/AG_SUPP_REQ/
     3        /IWFM/SR3/FLOW//1MON/AG_SUPP_REQ/
```

Urban Water Demand File Unit 20

This data file contains the time series data for the urban water demand for the modeled areas, which includes both the indoor and outdoor urban water use. The input data in this file is similar to the input data in the agricultural demand file (Unit 19). The appropriate conversion factor for the urban demand, the number of time steps to update the urban demand data and the repetition frequency of the data must be specified for the urban water demand time series data. The information to follow is the subregional urban water demand. In time tracking simulations the time series urban demand data can be either listed in this file or in a DSS file. If a DSS file is used for data input, then the name of the DSS file and the pathnames corresponding to each of the time series data are required.

The description of the variables used in Unit 20 is as follows:

FACTDU	Conversion factor for the spatial component of the unit for the urban water demand
NSPDU	Number of time steps to update the urban demand data. If time tracking simulation, enter any number.
NFQDU	Repetition frequency of the urban demand data (enter zero if full time series data is supplied). If time tracking simulation, enter any number.
DSSFL	If the time series data is stored in a DSS file, name of the file. Leave blank if the data is listed in the ASCII text file.

Data Input from ASCII Text File

If the time series data is listed in the same ASCII text file, then the following variables need to be populated. Otherwise, these variables should be commented out using “C”, “c” or “*”, and the variables in the “Data Input from DSS File” section below should be populated.

ITDU	Time. For time tracking simulations use MM/DD/YYYY_hh:mm format, for non-time tracking simulations enter an integer number.
RDMUR	Urban water demand specified for each subregion, [L^3/T]

Data Input from DSS File

If time series data is stored in a DSS file then the following variables should be populated:

IR	Subregion identification number
PATH	Pathname for the time series record that will be used for data retrieval

```
C*******************************************************************************
C
C                   INTEGRATED WATER FLOW MODEL (IWFM)
C                          *** Version ### ***
C
C*******************************************************************************
C
C                   URBAN WATER DEMAND DATA FILE
C                       for IWFM Simulation
C                            (Unit 20)
C
C
C              Project :  IWFM Version ### Release
C                         California Department of Water Resources
C              Filename:  URBDEMAND.DAT
C
C*******************************************************************************
C                             File Description
C
C   This data file contains the urban water demand on a time-series basis for each
C   subregion for the model simulation period. The urban water demand includes
C   indoor and outdoor water use for municipal and industrial purposes.
C
C*******************************************************************************
C                       Urban Water Demand Data Specifications
C
C   FACTDU;  Conversion factor for urban water demand
C             It is used to convert only the spatial component of the unit;
C             DO NOT include the conversion factor for time component of the unit.
C             * e.g. Unit of flow listed in this file         = AC-FT/MONTH
C                    Consistent unit used in simulation       = CU.FT/DAY
C                    Enter FACTDU (AC-FT/MONTH -> CU.FT/MONTH)= 2.29568E-05
C                     (conversion of MONTH -> DAY is performed automatically)
C   NSPDU ;  Number of time steps to update the urban water demand data
C             * Enter any number if time-tracking option is on
C   NFQDU ;  Repetition frequency of the urban water demand data
C             * Enter 0 if full time series data is supplied
C             * Enter any number if time-tracking option is on
C   DSSFL ;  The name of the DSS file for data input (maximum 50 characters);
C             * Leave blank if DSS file is not used for data input
C
C-------------------------------------------------------------------------------
C   VALUE                       DESCRIPTION
C-------------------------------------------------------------------------------
    43560000.0                  / FACTDU
    1                           / NSPDU
    0                           / NFQDU
                                / DSSFL
C-------------------------------------------------------------------------------
C                         Urban Water Demand Data
C                          (READ FROM THIS FILE)
C
C   List the urban water demand data below, if it will not be read from a
C   DSS file (i.e. DSSFL is left blank above).
C
C   ITDU;    Time
C   RDMUR;   Urban water demand by subregion; [L^3/T]
C
C-------------------------------------------------------------------------------
C   ITDU          RDMUR(1)  RDMUR(2)
C-------------------------------------------------------------------------------
01/31/1999_24:00    2.3     1.7
02/28/1999_24:00    2.0     1.6
03/31/1999_24:00    2.3     1.7
      .              .       .
      .              .       .
      .              .       .
08/31/2003_24:00    13.5    5.7
09/30/2003_24:00    11.6    5.1
C-------------------------------------------------------------------------------
C                     Pathnames for Urban Water Demand Data
C                            (READ FROM DSS FILE)
C
C   List the pathnames for the urban water demand data below, if it will be read
C   from a DSS file (i.e. DSSFL is specified above).
C
C   IR   ;  Sub-region number
C   PATH ;  Pathname for the time series record
C
C---------------------------------------------------------------------------------
C   IR       PATH
C---------------------------------------------------------------------------------
*
*
```

Stream Inflow File   Unit 21

The stream inflow data file contains the time series for all inflows into the modeled streams. Number of time steps to update the inflow data and repetition frequency are both set by the user. Stream nodes that receive inflow from outside the modeled area are specified, as well as the columns containing the values of stream inflow data to each of the listed stream nodes. If there is a zero for any given stream flow, then that column is not used in the simulation. To help identify the nodes, a description following the stream node number can be used. In time tracking simulations the time series stream inflow data can be either listed in this file or in a DSS file. If a DSS file is used for data input, then the name of the DSS file and the pathnames corresponding to each of the time series data are required.

The following variables are specified in this file:

NCOLSTRM	Total number of stream inflows
FACTSTRM	Conversion factor for the spatial component of the unit for the stream inflows
NSPSTRM	Number of time steps to update the stream inflows. If time tracking simulation, enter any number.
NFQSTRM	Repetition frequency of the stream inflow data. If time tracking simulation, enter any number.
DSSFL	If the time series data is stored in a DSS file, name of the file. Leave blank if the data is listed in the ASCII text file.

IRST	Stream node where inflow occurs; a value of zero in this column indicates that the corresponding data set is not used, and the stream inflow is taken to be zero

Data Input from ASCII Text File

If the time series data is listed in the same ASCII text file, then the following variables need to be populated. Otherwise, these variables should be commented out using “C”, “c” or “*”, and the variables in the “Data Input from DSS File” section below should be populated.

ITST	Time. For time tracking simulations use MM/DD/YYYY_hh:mm format, for non-time tracking simulations enter an integer number.
ASTRM	Stream inflow at the specified stream node; negative values indicate water removed from the corresponding stream node

Data Input from DSS File

If time series data is stored in a DSS file then the following variables should be populated:

REC	Record number that coincides with the data column number for the time series data
PATH	Pathname for the time series record that will be used for data retrieval

```
C*******************************************************************************
C
C              INTEGRATED WATER FLOW MODEL (IWFM)
C                     *** Version ### ***
C
C*******************************************************************************
C
C                 STREAM INFLOW DATA FILE
C                  for IWFM Simulation
C                       (Unit 21)
C
C
C            Project :  IWFM Version ### Release
C                       California Department of Water Resources
C            Filename:  INFLOW.DAT
C
C*******************************************************************************
C                          File Description
C
C   This data file contains the inflows to the stream nodes that are modeled.
C
C*******************************************************************************
C                      Stream Inflow Data Specifications
C
C   NCOLSTRM; Total number of stream inflows (or pathnames if DSS files are used)
C   FACTSTRM; Conversion factor for stream inflow
C              It is used to convert only the spatial component of the unit;
C              DO NOT include the conversion factor for time component of the unit.
C              * e.g. Unit of flow listed in this file          = AC-FT/MONTH
C                     Consistent unit used in simulation        = CU.FT/DAY
C                     Enter FACTSTRM (AC-FT/MONTH -> CU.FT/MONTH)= 2.29568E-05
C                      (conversion of MONTH -> DAY is performed automatically)
C   NSPSTRM ; Number of time steps to update the stream inflows
C              * Enter any number if time-tracking option is on
C   NFQSTRM ; Repetition frequency of the stream inflow data
C              * Enter 0 if full time series data is supplied
C              * Enter any number if time-tracking option is on
C   DSSFL   ; The name of the DSS file for data input (maximum 50 characters);
C              * Leave blank if DSS file is not used for data input
C
C-------------------------------------------------------------------------------
C   VALUE                       DESCRIPTION
C-------------------------------------------------------------------------------
    58                          /NCOLSTRM
    1452000.0                   /FACTSTRM
    1                           /NSPSTRM
    0                           /NFQSTRM
                                /DSSFL
C-------------------------------------------------------------------------------
C                     Stream Inflow Location Information
C
C   List the list nodes below where the inflow occurs.
C
C   IRST;    Stream node where inflow occurs
C             * Enter '0' if the corresponding data set is not used
C
C-------------------------------------------------------------------------------
C   IRST                        Stream Description (optional)
C-------------------------------------------------------------------------------
    205                         / 1:
    211                         / 2:
    220                         / 3:
      .                           .
      .                           .
      .                           .
      0                         /53:
      0                         /54:
     11                         /55:
    424                         /56:
     69                         /57:
     80                         /58:
C-------------------------------------------------------------------------------
C                          Stream Inflow Data
C                         (READ FROM THIS FILE)
C
C   List the stream inflow data below, if it will not be read from a DSS
C   file (i.e. DSSFL is left blank above).
C
C   ITST ;   Time
C   ASTRM;   Stream inflow at the stream node specified above; [L^3/T]
C             * Negative values indicate water being removed from the
C               corresponding stream node
C
C-------------------------------------------------------------------------------
C   ITST            ASTRM(1)  ASTRM(2)  ASTRM(3) ...
C-------------------------------------------------------------------------------
C                     1         2        3      ......  56      57      58
10/31/1921_24:00    232.00     7.50    15.70    ......  0.00    0.00    0.00
11/30/1921_24:00    237.00    22.50    19.50    ......  0.00    0.00    0.00
12/31/1921_24:00    335.00    49.60    29.10    ......  0.00    0.00    0.00
```

```
        .              .        .        .     ......    .       .       .
        .              .        .        .     ......    .       .       .
        .              .        .        .     ......    .       .       .
07/31/1998_24:00    912.60    19.92    50.24    ......   4.90    1.20    6.00
08/31/1998_24:00    903.68     9.10    33.20    ......   7.00    0.00    0.00
09/30/1998_24:00    660.97     7.14    26.72    ......   0.00    0.00    0.00
C-------------------------------------------------------------------------------
C                    Pathnames for Stream Inflow Data
C                         (READ FROM DSS FILE)
C
C   List the pathnames for the stream inflow data below, if it will be read
C   from a DSS file (i.e. DSSFL is specified above).
C
C   REC  ;  Time series record number
C   PATH ;  Pathname for the time series record
C
C--------------------------------------------------------------------------------
C   REC       PATH
C--------------------------------------------------------------------------------
*
*
```

Crop Demand Parameter File Unit 22

The data in this file is used to compute the agricultural water demand of each subregion in the modeled area for the simulation period. The user has the option to compute agricultural demand within IWFM by setting KOPTDM to 1 in the main input file (Unit 5) and specifying agricultural demand parameters or to specify agricultural demand in Unit 19, directly.

This file contains the minimum soil moisture requirements and seasonal application efficiency of each crop in every subregion within the modeled area, for a time period and frequency that is determined by the user. The top line of input for each time step (and subregion) is minimum soil moisture requirements and the bottom line is for the seasonal application efficiencies. In time tracking simulations the time series crop demand parameter data can be either listed in this file or in a DSS file. If a DSS file is used for data input, then the name of the DSS file and the pathnames corresponding to each of the time series data are required.

The following is a list of the variables used in this data file:

NSPDAG	Number of time steps to update the crop demand data. If time tracking simulation, enter any number.
NFQDAG	Repetition frequency of the crop demand data. If time tracking simulation, enter any number.
DSSFL	If the time series data is stored in a DSS file, name of the file. Leave blank if the data is listed in the ASCII text file.

Data Input from ASCII Text File

If the time series data is listed in the same ASCII text file, then the following variables need to be populated. Otherwise, these variables should be commented out using "C", "c" or "*", and the variables in the "Data Input from DSS File" section below should be populated.

TIME	Time. For time tracking simulations use MM/DD/YYYY_hh:mm format, for non-time tracking simulations enter an integer number.
IR	Subregion number
SMMIN	Minimum soil moisture requirement for a particular crop as a fraction of field capacity. It is given in the first data line for each region; [dimensionless]
CREFF	Crop efficiency for a particular crop at the specified time, given in the second data line for each region. If no irrigation is required, enter 0.

Data Input from DSS File

If time series data is stored in a DSS file then the following variables should be populated. The subregion and the agricultural crop identification numbers should be entered sequentially such that the crop identification number changes first. For a particular subregion, the pathnames for minimum soil moisture requirement for each crop followed by irrigation efficiency for each crop should be entered.

IR	Subregion identification number
CRTYPE	Crop identification number

PATH	Pathname for the time series data for the corresponding subregion/crop combination

```
C*******************************************************************************
C
C               INTEGRATED WATER FLOW MODEL (IWFM)
C                      *** Version ### ***
C
C*******************************************************************************
C
C               CROP DEMAND PARAMETER DATA FILE
C                   for IWFM Simulation
C                        (Unit 22)
C
C
C             Project :  IWFM Version ### Release
C                        California Department of Water Resources
C             Filename:  CROPDEMAND.DAT
C
C*******************************************************************************
C                          File Description
C
C   This data file contains the minimum soil moisture requirements and the
C   crop efficiency for each crop.
C
C*******************************************************************************
C          Minimum Soil Moisture Requirements and Crop Efficiency
C                          Data Specifications
C
C   NSPDAG ; Number of time steps to update the crop demand parameter data
C              * Enter any number if time-tracking option is on
C   NFQDAG ; Repetition frequency of the crop demand data
C              * Enter 0 if full time series data is supplied
C              * Enter any number if time-tracking option is on
C   DSSFL  ; The name of the DSS file for data input (maximum 50 characters);
C              * Leave blank if DSS file is not used for data input
C
C-------------------------------------------------------------------------------
C    VALUE                      DESCRIPTION
C-------------------------------------------------------------------------------
     30                         / NSPDAG
     12                         / NFQDAG
                                / DSSFL
C-----------------------------------------------------------------------------------------------
C                         Crop Demand Parameter Data
C                           (READ FROM THIS FILE)
C
C   List the crop demand parameter data below, if it will not be read from
C   a DSS file (i.e. DSSFL is left blank above).
C
C   TIME ;  Time
C   IR   ;  Region number
C   SMMIN;  Minimum soil moisture requirement for a particular crop as a fraction of field
C             capacity. It is given in the first data line for each region; [dimensionless]
C   CREFF;  Crop efficiency for a particular crop at the specified time. It is
C             given in the second data line for each region.If no irrigation is
C             required, enter 0.
C
C--------------------------------------------------------------------------------------------------
C                        SMMIN(1)  SMMIN(2)  SMMIN(3) ...
C  TIME             IR   CREFF(1)  CREFF(2)  CREFF(3) ...
C--------------------------------------------------------------------------------------------------
 10/31/4000_24:00    1   0.44      0.50
                         0.65      0.70
                     2   0.44      0.50
                         0.65      0.70
 11/30/4000_24:00    1   0.44      0.50
                         0.65      0.70
                     2   0.44      0.50
                         0.65      0.70
          .          .    .          .
                          .          .
                     .    .          .
                          .          .
          .          .    .          .
                          .          .
                     .    .          .
                          .          .
          .          .    .          .
                          .          .
                     .    .          .
 08/31/4000_24:00    1   0.44      0.50
                         0.65      0.70
                     2   0.44      0.50
                         0.65      0.70
 09/30/4000_24:00    1   0.44      0.50
                         0.65      0.70
                     2   0.44      0.50
                         0.65      0.70
C-------------------------------------------------------------------------------
C                      Pathnames for Crop Demand Parameter Data
C                              (READ FROM DSS FILE)
C
C   List the pathnames for crop demand parameter data below, if it will be read
C   from a DSS file (i.e. DSSFL is specified above).
C
C   The pathnames should be listed for each subregion and crop type combination.
C   They should be listed in the order given in the example below.
C
C   * Example [simulation includes 3 agricultural crops]
C
```

```
C       IR     CRTYPE      PATH
C        1        1       (pathname[1])            => Sub-region 1; crop 1; minimum soil moisture requirement
C        1        2       (pathname[2])            => Sub-region 1; crop 2; minimum soil moisture requirement
C        1        3       (pathname[3])            => Sub-region 1; crop 3; minimum soil moisture requirement
C        1        1       (pathname[4])            => Sub-region 1; crop 1; crop irrigation efficiency
C        1        2       (pathname[5])            => Sub-region 1; crop 2; crop irrigation efficiency
C        1        3       (pathname[6])            => Sub-region 1; crop 3; crop irrigation efficiency
C        2        1       (pathname[7])            => Sub-region 2; crop 1; minimum soil moisture requirement
C        2        2       (pathname[8])            => Sub-region 2; crop 2; minimum soil moisture requirement
C        2        3       (pathname[9])            => Sub-region 2; crop 3; minimum soil moisture requirement
C        2        1       (pathname[10])           => Sub-region 2; crop 1; crop irrigation efficiency
C        2        2       (pathname[11])           => Sub-region 2; crop 2; crop irrigation efficiency
C        2        3       (pathname[12])           => Sub-region 2; crop 3; crop irrigation efficiency
C        .        .            .
C        .        .            .
C        .        .            .
C       NREGN     1       (pathname[(6*NREGN)-5])   => Sub-region NREGN; crop 1; minimum soil moisture requirement
C       NREGN     2       (pathname[(6*NREGN)-4])   => Sub-region NREGN; crop 2; minimum soil moisture requirement
C       NREGN     3       (pathname[(6*NREGN)-3])   => Sub-region NREGN; crop 3; minimum soil moisture requirement
C       NREGN     1       (pathname[(6*NREGN)-2])   => Sub-region NREGN; crop 1; crop irrigation efficiency
C       NREGN     2       (pathname[(6*NREGN)-1])   => Sub-region NREGN; crop 2; crop irrigation efficiency
C       NREGN     3       (pathname[(6*NREGN)  ])   => Sub-region NREGN; crop 3; crop irrigation efficiency
C
C   IR    ;  Sub-region number
C   CRTYPE;  Crop type number
C   PATH  ;  Pathname for the time series record
C
C-----------------------------------------------------------------------------------------------------------
C   IR      CRTYPE     PATH
C-----------------------------------------------------------------------------------------------------------
*
*
```

Pumping Specification File Unit 23

The pumping specification data file contains the information for all wells and/or elemental sinks within the modeled area. The number of sinks as well as the distribution options for groundwater pumping should also be set. The subregion number that the pumping is delivered to and the corresponding column in the supply adjustment specification data file (Unit 12) are also listed in this file. Note that the maximum pumping amounts that are used during automated supply adjustment to limit the pumping amounts (see variables ICWLMAX, FWLMAX, ICSKMAX and FSKMAX) are not utilized in this version of IWFM. The relative proportions (or fractions) of pumping by aquifer layers are also listed for each sink.

The variable descriptions for the pumping data file are as follows:

NSINK	Number of elements where pumping is taking place
IOPT	Option for distributing the groundwater pumping (0 = distribute pumping according to the specified fractions, 1 = distribute pumping in proportion to the specified fraction multiplied by the total area of the element, 2 = distribute pumping in proportion to the specified fraction multiplied by the total of agricultural and urban area within the element, 3 = distribute pumping in proportion to the specified fraction multiplied by the agricultural area of the element, 4 = distribute pumping in proportion to the specified fraction multiplied by the urban area of the element)
ID	Well/element identification number

ICOLWL	Well pumping (this number corresponds to the appropriate data column in the pumping data file, Unit 24)
ICFIRIGWL	Fraction of the well pumping that is used for agricultural purposes (this number corresponds to the data column in the irrigation fractions data file, Unit 27)
FRACWL	Relative proportion of the pumping as specified by ICOLWL to be applied to well, ID
IRGWL	Subregion number where the pumping from a well is delivered to; enter zero if pumping is exported outside the model area, enter −1 if the pumping is used in the same element that the well is located
ICADJWL	Supply adjustment specification (this number corresponds to the data column in the supply adjustment specifications data file, Unit 12)
ICWLMAX	Maximum pumping amount to be used during automated supply adjustment (this number corresponds to the data column in the pumping data file, Unit 24); not utilized in this version of IWFM
FWLMAX	Fraction of data value specified in column ICWLMAX to be used as maximum pumping amount; not utilized in this version of IWFM
ICOLSK	Data column in the pumping data file (Unit 24) which corresponds to sink ID

ICFIRIGSK	Fraction of the elemental pumping that is used for agricultural purposes (this number corresponds to the data column in the irrigation fractions data file, Unit 27)
FRACSK	Relative proportion of the pumping in column ICOLSK to be applied to element ID
FRACSKL	The distribution factor of elemental pumping for each layer (i.e. for layers 1 to NL)
IRGSK	Subregion number where the pumping is delivered to; enter zero if pumping is exported outside the model area; enter –1 if the pumping is used in the same element
ICADJSK	Supply adjustment specification (this number corresponds to the data column in the supply adjustment specifications data file, Unit 12)
ICSKMAX	Maximum pumping amount to be used during automated supply adjustment (this number corresponds to the data column in the pumping data file, Unit 24); not utilized in this version of IWFM
FSKMAX	Fraction of data value specified in column ICSKMAX to be used as maximum pumping amount; not utilized in this version of IWFM

```
C*******************************************************************************
C
C               INTEGRATED WATER FLOW MODEL (IWFM)
C                      *** Version ### ***
C
C*******************************************************************************
C
C                PUMPING SPECIFICATION DATA FILE
C                    for IWFM Simulation
C                         (Unit 23)
C
C
C             Project :  IWFM Version ### Release
C                        California Department of Water Resources
C             Filename:  PUMPSPEC.DAT
C
C*******************************************************************************
C                          File Description
C
C   This data file contains the specification data for well pumping and
C   element pumping (sinks).
C
C*******************************************************************************
C                      General Pumping Specifications
C
C   NSINK ;  Number of elements used for element pumping
C
C   IOPT  ;  Option for distribution of element pumping (enter a value for each element pumping column)
C             Enter 0 - to distribute the pumping according to the given fraction
C                       below
C             Enter 1 - to distribute the pumping in proportion to the fraction
C                       times the total area of the element
C             Enter 2 - to distribute the pumping in proportion to the fraction
C                       times the developed area (ag. and urban) within the element
C             Enter 3 - to distribute the pumping in proportion to the fraction
C                       times the developed area (ag. only) within the element
C             Enter 4 - to distribute the pumping in proportion to the fraction
C                       times the developed area (urban only) with the element
C-------------------------------------------------------------------------------
C   VALUE                         DESCRIPTION
C-------------------------------------------------------------------------------
     5                            / NSINK
     0 3                          / IOPT
C-------------------------------------------------------------------------------
C*******************************************************************************
C                   Well Pumping Specifications
C   (Skip if no wells are being modeled, ie, NWELL = 0 as specified in preprocessor)
C
C   ID       ; Well identification number
C   ICOLWL   ; Well pumping - this number corresponds to the appropriate data column
C               in the pumping data file (Unit 24)
C   ICFIRIGWL; Fraction of the pumping that is used for irrigation purposes -
C               this number corresponds to the appropriate data column in the
C               irrigation fractions data file (Unit 27)
C   FRACWL   ; Relative proportion of the pumping in column ICOLWL to be applied
C               to well ID
C   IRGWL    ; Subregion number where the pumping is delivered to;
C               Enter 0, if pumping is exported to outside the model area
C               Enter -1, if the pumping is used in the same element
C   ICADJWL  ; Supply adjustment specification - this number corresponds to
C               the data column in the supply adjustment specifications
C               data file (Unit 12)
C   ICWLMAX  ; Maximum pumping amount - this number corresponds to the
C               appropriate data column in the pumping data file (Unit 24)
C   FWLMAX   ; Fraction of data value specified in column ICWLMAX to be used as
C               maximum pumping amount
C
C-------------------------------------------------------------------------------
C   ID   ICOLWL   ICFIRIGWL     FRACWL     IRGWL    ICADJWL  ICWLMAX  FWLMAX
C-------------------------------------------------------------------------------
*
*
C-------------------------------------------------------------------------------
C*******************************************************************************
C                      Elemental Pumping Specifications
C         (Skip if elemental pumping is not specified, ie, NSINK = 0)
C
C   ID       ; Element identification number corresponding to the pumping
C   ICOLSK   ; Element pumping - this number corresponds to the appropriate data
C               column in the pumping data file (Unit 24)
C   ICFIRIGSK; Fraction of the pumping that is used for irrigation purposes -
C               this number corresponds to the appropriate data column in the
C               irrigation fractions data file (Unit 27)
C   FRACSK   ; Relative proportion of the pumping in column ICOLSK to be applied
C               to element ID
C   FRACSKL  ; The distribution factor of pumping for each aquifer layer; i.e. for
C               layers 1 to NL
C   IRGSK    ; Subregion number where the pumping is delivered to
C               Enter 0, if pumping is exported to outside the model area
C               Enter -1, if the pumping is used in the same element
C   ICADJSK  ; Supply adjustment specification - this number corresponds to
C               the data column in the supply adjustment specifications
C               data file (Unit 12)
C   ICSKMAX  ; Maximum pumping amount - this number corresponds to the
C               appropriate data column in the pumping data file (Unit 24)
C   FSKMAX   ; Fraction of data value specified in column ICSKMAX to be used as
C               maximum pumping amount
C
```

```
C-----------------------------------------------------------------------------------------------
C ID  ICOLSK  ICFIRIGSK  FRACSK   FRACSKL(1) FRACSKL(2)  IRGSK   ICADJSK    ICSKMAX  FSKMAX
C-----------------------------------------------------------------------------------------------
  73     1      2         1.0        1.0         1.0       1       1          0       0.0
  193    1      2         1.0        1.0         1.0       1       1          0       0.0
  333    1      1         1.0        1.0         1.0       2       1          0       0.0
  134    2      0         1.0        1.0         1.0       0       1          0       0.0
  274    2      0         1.0        1.0         1.0       0       1          0       0.0
```

Pumping Data File Unit 24

The pumping data file contains the time series information for the specified wells and/or elemental sinks from the pumping specification file (Unit 23). This file lists the number of pumping sets followed by conversion factor for the pumping data, number of time steps to update pumping and the repetition frequency for the pumping data. In time tracking simulations the time series pumping data can be either listed in this file or in a DSS file. If a DSS file is used for data input, then the name of the DSS file and the pathnames corresponding to each of the time series data are required.

The following is a list of the variables used in this data file:

NCOLPUMP	Number of pumping sets
FACTPUMP	Conversion factor for the spatial component of the unit for the pumping data
NSPPUMP	Number of time steps to update pumping data. If time tracking simulation, enter any number.
NFQPUMP	Repetition frequency of the pumping data (enter 0 if full time series data is supplied). If time tracking simulation, enter any number.
DSSFL	If the time series data is stored in a DSS file, name of the file. Leave blank if the data is listed in the ASCII text file.

Data Input from ASCII Text File

If the time series data is listed in the same ASCII text file, then the following variables need to be populated. Otherwise, these variables should be commented out

using “C”, “c” or “*”, and the variables in the “Data Input from DSS File” section below should be populated.

ITPU	Time. For time tracking simulations use MM/DD/YYYY_hh:mm format, for non-time tracking simulations enter an integer number.
APUMP	Pumping rate (a negative value represents pumping whereas a positive value represents recharge), [L^3/T]

Data Input from DSS File

If time series data is stored in a DSS file then the following variables should be populated:

REC	Record number that coincides with the data column number for the time series data
PATH	Pathname for the time series record that will be used for data retrieval

```
C*******************************************************************************
C
C                 INTEGRATED WATER FLOW MODEL (IWFM)
C                        *** Version ### ***
C
C*******************************************************************************
C
C                       PUMPING DATA FILE
C                      for IWFM Simulation
C                           (Unit 24)
C
C              Project :  IWFM Version ### Release
C                         California Department of Water Resources
C              Filename:  PUMP.DAT
C
C*******************************************************************************
C                            File Description:
C
C   This data file contains the pumping data for each set of pumping
C   specified in the pumping specification file.
C
C*******************************************************************************
C                         Pumping Data Specifications
C
C   NCOLPUMP; Number of pumping sets (or pathnames if DSS files are used)
C   FACTPUMP; Conversion factor for pumping data
C              It is used to convert only the spatial component of the unit;
C              DO NOT include the conversion factor for time component of the unit.
C              * e.g. Unit of pumping listed in this file        = AC-FT/MONTH
C                     Consistent unit used in simulation         = CU.FT/DAY
C                     Enter FACTPUMP (AC-FT/MONTH -> CU.FT/MONTH)= 2.29568E-05
C                      (conversion of MONTH -> DAY is performed automatically)
C   NSPPUMP ; Number of time steps to update pumping data
C              * Enter any number if time-tracking option is on
C   NFQPUMP ; Repetition frequency of the pumping data
C              * Enter 0 if full time series data is supplied
C              * Enter any number if time-tracking option is on
C   DSSFL   ; The name of the DSS file for data input (maximum 50 characters);
C              * Leave blank if DSS file is not used for data input
C
C-------------------------------------------------------------------------------
C   VALUE                       DESCRIPTION
C-------------------------------------------------------------------------------
    2                           / NCOLPUMP
    1452000.0                   / FACTPUMP
    1                           / NSPPUMP
    1                           / NFQPUMP
                                / DSSFL
C-------------------------------------------------------------------------------
C                               Pumping Data
C                          (READ FROM THIS FILE)
C
C   List the pumping data below if it will not be read from a DSS file (i.e.
C   DSSFL is left blank above).
C
C   For pumping enter negative values, for recharge enter positive values.
C
C   ITPU ;   Time
C   APUMP;   Pumping rate; [L^3/T]
C
C-------------------------------------------------------------------------------
C ITPU             APUMP(1)  APUMP(2)  APUMP(3) ...
C-------------------------------------------------------------------------------
01/31/1961_24:00     -3.50      0.00
02/28/1961_24:00     -3.50      0.00
03/31/1961_24:00     -3.50      0.00
04/30/1961_24:00     -3.50      0.00
05/31/1961_24:00     -3.50      0.00
06/30/1961_24:00     -3.50      0.00
07/31/1961_24:00      0.00      6.00
08/31/1961_24:00      0.00      6.00
09/30/1961_24:00      0.00      6.00
10/31/1961_24:00      0.00      6.00
11/30/1961_24:00      0.00      6.00
12/31/1961_24:00      0.00      6.00
C-------------------------------------------------------------------------------
C                        Pathnames for Pumping Data
C                          (READ FROM DSS FILE)
C
C   List the pathnames for pumping data below if it will be read from a DSS file
C   (i.e. DSSFL is specified above).
C
C   REC  ;   Time series record number
C   PATH ;   Pathname for the time series record
C
C-------------------------------------------------------------------------------
C   REC       PATH
C-------------------------------------------------------------------------------
*
*
```

Diversion Specification File Unit 25

This data file specifies the surface water diversion locations, bypass locations and recharge zones for all diversions and bypasses modeled. Deliveries, recoverable losses and non-recoverable losses are specified for each diversion and bypass.

Surface Water Diversions

The first portion of the data file includes the number of surface water diversions modeled and the diversion specifications for each diversion modeled. Based on this information, the appropriate diversion data columns in Unit 26 are used to model diversions.

NRDV	Number of surface water diversions in the model
ID	Surface water diversion identification number
IRDV	Stream node from where the diversion takes place. Enter '0' if the stream node is not within the model domain
ICDVMAX	Maximum diversion amount (this number corresponds to the data column in the diversion data file, Unit 26); not utilized in this version of IWFM
FDVMAX	Fraction of data value specified in column ICDVMAX to be used as maximum diversion amount; not utilized in this version of IWFM
ICOLRL	Column number in the diversion data file used to define the recoverable loss corresponding to diversion number ID

FRACRL	Relative proportion of the data value that is specified by ICOLRL to be used as recoverable loss
ICOLNL	Column number in the diversion data file that corresponds to the non-recoverable loss from diversion number ID
FRACNL	Relative proportion of the data value that is specified by ICOLNL to be used as non-recoverable loss
NDLDV	Number of subregions to which diverted surface water is delivered
IRGDL	Subregion number to which the delivery is made (1...NDLV)
ICOLDL	Delivery to subregion IRGDL; this number corresponds to the appropriate data column in the diversion data file (Unit 26)
FRACDL	Relative proportion of the data value that is specified by ICOLDL to be used as delivery to subregion IRGDL
ICFSIRIG	Fraction of the delivery that is used for irrigation purposes (remaining amount will be used to supply the user specified urban demand)
ICADJ	Supply adjustment specification (this number corresponds to the appropriate data column in the supply adjustment specifications data file (Unit 12)

Recharge Zone for Each Diversion Point

Each diversion point must have a related recharge zone. The recoverable loss specified above becomes groundwater recharge at the recharge zone which comprises of elements. The following list describes the variables used to indicate a recharge zone for each diversion point:

ID	Recharge zone identification number; recharge zone ID should be the same as diversion identification number
NERELS	Total number of elements through which recharge occurs
IERELS	Element number through which recharge occurs
FERELS	Relative proportion of the recoverable loss to be applied to element IERELS as recharge

Bypass Configuration Specifications

This portion indicates the total number of bypasses modeled, conversion factors, as well as each bypass identification number and the related bypass information. This information defines the stream nodes that the bypass originates from and ends at, and either diversion flows or a rating table detailing the available flows for each bypass number:

NDIVS	Number of bypasses modeled
FACTX	Factor to convert the spatial component of the unit for DIVX to the simulation unit of volume
TUNITX	Time unit of stream flow. This should be one of the units recognized by HEC-DSS that are listed in the Main Control File.
FACTY	Factor to convert the spatial component of the unit for DIVY to the simulation unit of volume

TUNITY	Time unit of diversion. This should be one of the units recognized by HEC-DSS that are listed in the Main Control File.
ID	Bypass identification number
IA	Stream node number where bypass flow is exported from
IDIVT	Stream node number where bypass flow is imported to
IDIVC	If positive, IDIVC is the column number in the diversion data file (Unit 26) to be used for bypass flow. If negative, IDIVC is the number of points in the rating table
DIVRL	Fraction of the bypass assigned as recoverable loss
DIVNL	Fraction of the bypass assigned as non-recoverable loss
DIVX	Stream flow available at stream node IA, [L^3/T]
DIVY	Bypass amount corresponding to DIVX, [L^3/T]

Seepage Locations for Bypass Canals

This section of data serves a similar purpose as the data that defines a recharge zone for each diversion point modeled. For each bypass modeled, the seepage to groundwater occurring from a bypass flow is based on the bypass recoverable loss. The following parameters define the elements where seepage from a bypass occurs, as well as the amount of the recoverable loss from a bypass flow that seeps into the groundwater.

ID	Recharge zone identification number; recharge zone ID should match bypass identification number
NERELS	Total number of elements encompassing the recharge zone associated with the corresponding bypass

IERELS	Element number included in the recharge zone associated with the bypass. If water is bypassed to a lake, specify IERELS as the lake identification number and include a negative sign prior to the lake ID
FERELS	Relative proportion of the recoverable loss to be applied to element IERELS as recharge

```
C*******************************************************************************
C
C                  INTEGRATED WATER FLOW MODEL (IWFM)
C                         *** Version ### ***
C
C*******************************************************************************
C
C             SURFACE WATER DIVERSION SPECIFICATION DATA FILE
C                         for IWFM Simulation
C                              (Unit 25)
C
C
C             Project :  IWFM Version ### Release
C                        California Department of Water Resources
C             Filename:  DIVERSPEC.DAT
C
C*******************************************************************************
C                          File Description
C
C  This data file contains the specification data for surface water diversions
C  and bypasses.
C
C*******************************************************************************
C                 Surface Water Diversion Specifications
C
C   The following lists the number of surface water diversions and
C   specifications for each diversion that is included in the model.
C
C   NRDV;    Number of surface water diversions included in the model.
C-------------------------------------------------------------------------------
C   VALUE                         DESCRIPTION
C-------------------------------------------------------------------------------
     4                            / NRDV
C-------------------------------------------------------------------------------
C
C   The following lists the specifications for each surface water diversion
C   (skip if no diversions are modeled, i.e. NRDV = 0)
C
C   ID      ; Surface water diversion identification number
C   IRDV    ; Stream node from where the diversion takes place. Enter '0' if
C              the stream node is outside the model area.
C   ICDVMAX ; Maximum diversion amount - this number corresponds to the
C              appropriate data column in the diversion data file Unit 26
C   FDVMAX  ; Fraction of data value specified in column ICDVMAX to be used as
C              maximum diversion amount
C   ICOLRL  ; Recoverable loss -  this number corresponds to the appropriate
C              data column in the diversion data file Unit 26
C   FRACRL  ; Relative proportion of the data value that is specified by ICOLRL
C              to be used as recoverable loss
C   ICOLNL  ; Non-recoverable loss - this number corresponds to the appropriate
C              data column in the diversion data file Unit 26
C   FRACNL  ; Relative proportion of the data value that is specified by ICOLNL
C              to be used as non-recoverable loss
C   NDLDV   ; Number  of sub-regions to which diverted surface water is delivered
C   IRGDL   ; Sub-region number to which the delivery is made (1...NDLDV)
C   ICOLDL  ; Delivery to sub-region IRGDL - this number corresponds to the
C              appropriate data column in the diversion data file Unit 26
C   FRACDL  ; Relative proportion of the data value that is specified by ICOLDL
C              to be used as delivery to subregion IRGDL
C   ICFSIRIG; Fraction of the delivery that is used for irrigation purposes -
C              this number corresponds to the appropriate data column in the
C              irrigation fraction data file Unit 27 (remaining amount will be used to
C              supply the user specified urban demand)
C   ICADJ   ; Supply adjustment specification - this number corresponds to the appropriate
C              data column in the supply adjustment specifications data file Unit 12
C
C-----------------------------------------------------------------------------------------------------------------------
C   ID   IRDV  ICDVMAX  FDVMAX  ICOLRL   FRACRL    ICOLNL   FRACNL   NDLDV  IRGDL   ICOLDL   FRACDL  ICFSIRIG  ICADJ
C-----------------------------------------------------------------------------------------------------------------------
     1    9       0      0.0     1         0.01      1        0.01      1      1        1        0.98     2         0
     2    12      0      0.0     2         0.02      2        0.02      2      1        2        0.98     2         0
                                                                               0        3        0.98     3         0
     3    0       0      0.0     4         0.01      4        0.01      1      1        4        0.98     2         0
     4    22      0      0.0     5         0.01      5        0.01      1      0        5        0.98     4         0
C-----------------------------------------------------------------------------------------------------------------------
C
C                  Recharge zone for each diversion point
C        (Skip if no diversions are being modeled, i.e. NRDV = 0)
C
C   ID    ;  Recharge zone identification number
C             (*Note* Recharge zone ID's should match river diversion ID numbers)
C   NERELS;  Total number of elements through which recharge occurs
C   IERELS;  Element number through which recharge occurs
C   FERELS;  Relative proportion of the recoverable loss to be applied to
C               element IERELS as recharge
C
C-------------------------------------------------------------------------------
C    ID         NERELS      IERELS     FERELS
C-------------------------------------------------------------------------------
     1           2           251        1.0
```

```
                             270        1.0
     2           1           191        1.0
     3           0           0          0.0
     4           0           0          0.0
C-------------------------------------------------------------------------------
C*******************************************************************************
C
C                 Bypass Configuration Specifications
C
C   NDIVS;  Number of bypasses
C   FACTX;  Conversion factor for DIVX
C            It is used to convert only the spatial component of the unit;
C            DO NOT include the conversion factor for time component of the unit.
C            * e.g. Unit of stream flow listed in this file   = AC-FT/MONTH
C                   Consistent unit used in simulation        = CU.FT/DAY
C                   Enter FACTX (AC-FT/MONTH -> CU.FT/MONTH)  = 2.29568E-05
C                    (conversion of MONTH -> DAY is performed automatically)
C   TUNITX; Time unit of stream flow.  This should be one of the units
C            recognized by HEC-DSS that are listed in the Main Control File.
C   FACTY;  Conversion factor for DIVY
C            It is used to convert only the spatial component of the unit;
C            DO NOT include the conversion factor for time component of the unit.
C            * e.g. Unit of diversion listed in this file     = AC-FT/MONTH
C                   Consistent unit used in simulation        = CU.FT/DAY
C                   Enter FACTY (AC-FT/MONTH -> CU.FT/MONTH)  = 2.29568E-05
C                    (conversion of MONTH -> DAY is performed automatically)
C   TUNITY; Time unit of diversion.  This should be one of the units
C            recognized by HEC-DSS that are listed in the Main Control File.
C   ID   ;  Bypass identification number
C   IA   ;  Stream node number where bypass is exported
C   IDIVT;  Stream node number where bypass is imported
C   IDIVC;  If positive, IDIVC is the column number in the diversion data file Unit 26 for bypass flow
C           If negative, IDIVC is the number of points in the diversion rating table
C   DIVRL;  Fraction of the diversion assigned as recoverable loss
C   DIVNL;  Fraction of the diversion assigned as non-recoverable loss
C   DIVX ;  Stream flow available at stream node IA; [L^3/T]
C   DIVY ;  Diversion amount corresponding to DIVX; [L^3/T]
C
C-------------------------------------------------------------------------------
C   VALUE                        DESCRIPTION
C-------------------------------------------------------------------------------
     2                            / NDIVS
     43560.0                      / FACTX
     1MON                         / TUNITX
     43560.0                      / FACTY
     1MON                         / TUNITY
C-----------------------------------------------------------------------------------------------------
C  ID   IA  IDIVT   IDIVC   DIVRL  DIVNL
C                           DIVX   DIVY ( this rating table should follow if IDIVC < 0 )
C-----------------------------------------------------------------------------------------------------
   1    13      0     6      0.0     0.0
   2    17     21    -4      0.0     0.1
                             0.0     0.0
                             1.0     0.5
                             18.0    9.0
                             8000.0  4000.0
C----------------------------------------------------------------------------------
C
C               Seepage locations for bypass canals
C
C      The following information specifies the recharge zone for each bypass.
C      (Skip if no bypass is being modeled, i.e. NDIVS = 0)
C
C   ID    ;  Recharge zone identification number
C             (*Note* Recharge zone ID's should match bypass ID numbers)
C   NERELS;  Total number of elements through which recharge occurs
C   IERELS;  Element number through which recharge occurs
C             (If bypass to lake elements, provide negative sequential lake
C              number, as in the LAKE input data file)
C   FERELS;  Relative proportion of the recoverable loss to be applied to
C             element IERELS as recharge.
C
C-------------------------------------------------------------------------------
C    ID         NERELS      IERELS     FERELS
C-------------------------------------------------------------------------------
   1              0            0         0
   2              0            0         0
```

Surface Water Diversion Data File Unit 26

The surface water diversion data file contains the diversions within the modeled area for the simulation time period. This data file is used in conjunction with the surface water diversion specification file (Unit 25) to route the water to delivery points, indicate bypass flows, the recoverable losses with respect to recharge zone and the non-recoverable losses. In time tracking simulations the time series diversions data can be either listed in this file or in a DSS file. If a DSS file is used for data input, then the name of the DSS file and the pathnames corresponding to each of the time series data are required.

The following is a list of the variables used in this data file:

NCOLDV	Number of surface water diversion points
FACTDV	Conversion factor for the spatial component of the unit for the surface water diversion data
NSPDV	Number of time steps to update the surface water diversion data. If time tracking simulation, enter any number.
NFQDV	Repetition frequency of the surface water diversion data; a value of zero indicates that a full time series data set is supplied. If time tracking simulation, enter any number.
DSSFL	If the time series data is stored in a DSS file, name of the file. Leave blank if the data is listed in the ASCII text file.

Data Input from ASCII Text File

If the time series data is listed in the same ASCII text file, then the following variables need to be populated. Otherwise, these variables should be commented out using "C", "c" or "*", and the variables in the "Data Input from DSS File" section below should be populated.

ITDV	Time. For time tracking simulations use MM/DD/YYYY_hh:mm format, for non-time tracking simulations enter an integer number.
ADIVS	Diversion rate corresponding to the stream node specified in diversion specification file, $[L^3/T]$

Data Input from DSS File

If time series data is stored in a DSS file then the following variables should be populated:

REC	Record number that coincides with the data column number for the time series data
PATH	Pathname for the time series record that will be used for data retrieval

```
C*******************************************************************************
C
C                  INTEGRATED WATER FLOW MODEL (IWFM)
C                         *** Version ### ***
C
C*******************************************************************************
C
C                  SURFACE WATER DIVERSION DATA FILE
C                        for IWFM Simulation
C                             (Unit 26)
C
C
C             Project :  IWFM Version ### Release
C                        California Department of Water Resources
C             Filename:  DIVER.DAT
C
C*******************************************************************************
C                             File Description
C
C   This data file contains the surface water diversion and bypass data
C   for the stream nodes that have been specified in the surface water
C   diversion specification data file. Maximum diversion rates to be used
C   in supply adjutment computations are also listed in this file.
C
C*******************************************************************************
C                    Surface Water Diversion Data Specifications
C
C   The following lists the time-series surface water diversions for
C   each of the stream nodes where surface diversions have been specified.
C
C   NCOLDV;  Number of surface water diversions (or pathnames if DSS files are used)
C   FACTDV;  Conversion factor for surface water diversions
C             It is used to convert only the spatial component of the unit;
C             DO NOT include the conversion factor for time component of the unit.
C             * e.g. Unit of diversion listed in this file    = AC-FT/MONTH
C                    Consistent unit used in simulation       = CU.FT/DAY
C                    Enter FACTDV (AC-FT/MONTH -> CU.FT/MONTH)= 2.29568E-05
C                     (conversion of MONTH -> DAY is performed automatically)
C   NSPDV ;  Number of time steps to update the surface water diversion data
C             * Enter any number if time-tracking option is on
C   NFQDV ;  Repetition frequency of the surface water diversion data
C             * Enter 0 if full time series data is supplied
C             * Enter any number if time-tracking option is on
C   DSSFL ;  The name of the DSS file for data input (maximum 50 characters);
C             * Leave blank if DSS file is not used for data input
C
C-------------------------------------------------------------------------------
C    VALUE                      DESCRIPTION
C-------------------------------------------------------------------------------
     5                          / NCOLDV
     1452000.0                  / FACTDV
     1                          / NSPDV
     0                          / NFQDV
     TSDATA_IN.DSS              / DSSFL
C*******************************************************************************
C                       Surface Water Diversion Data
C                          (READ FROM THIS FILE)
C
C   List the diversion data below, if it will not be read from a DSS file (i.e.
C   DSSFL is left blank above).
C
C   ITDV ;  Time
C   ADIVS;  Diversion rate corresponding to the stream node specified; [L^3/T]
C            in diversion specification file (if the data column is used for maximum
C            diversion rate, then a value of -99.0 denotes that there is no upper
C            limit for the diversion rate)
C
C-------------------------------------------------------------------------------
C   ITDV   ADIVS(1)  ADIVS(2)  ADIVS(3) ...
C-------------------------------------------------------------------------------
*
*
C-------------------------------------------------------------------------------
C                Pathnames for Surface Water Diversion Data
C                         (READ FROM DSS FILE)
C
C   List the pathnames for diversion data below, if it will be read from a DSS file
C   (i.e. DSSFL is specified above).
C
C   REC  ;   Time series record number
C   PATH ;   Pathname for the time series record
C
C-------------------------------------------------------------------------------
C   REC       PATH
C-------------------------------------------------------------------------------
     1        /IWFM/DIV1/FLOW//1DAY/DIVERSION/
     2        /IWFM/DIV2/FLOW//1DAY/DIVERSION/
     3        /IWFM/DIV3/FLOW//1DAY/DIVERSION/
     4        /IWFM/DIV4/FLOW//1DAY/DIVERSION/
     5        /IWFM/DIV5/FLOW//1DAY/DIVERSION/
```

Irrigation Fractions Data File Unit 27

This data file contains the time series data for the fraction of pumping and surface water diversions to be used for agricultural purposes. The pumping and surface water diversions are associated with each of the data columns through pumping specifications (Unit 23) and surface water diversion specification (Unit 25) data files. In time tracking simulations the time series irrigation fractions data can be either listed in this file or in a DSS file. If a DSS file is used for data input, then the name of the DSS file and the pathnames corresponding to each of the time series data are required.

The following is a list of the variables used in this data file:

NCOLIRF	Number of columns in the irrigation fractions data file
NSPIRF	Number of time steps to update the irrigation fractions. If time tracking simulation, enter any number.
NFQIRF	Repetition frequency of the irrigation fractions data; a value of zero indicates that a full time series data set is supplied. If time tracking simulation, enter any number.
DSSFL	If the time series data is stored in a DSS file, name of the file. Leave blank if the data is listed in the ASCII text file.

Data Input from ASCII Text File

If the time series data is listed in the same ASCII text file, then the following variables need to be populated. Otherwise, these variables should be commented out using “C”, “c” or “*”, and the variables in the “Data Input from DSS File” section below should be populated.

ITIRF — Time. For time tracking simulations use MM/DD/YYYY_hh:mm format, for non-time tracking simulations enter an integer number.

FIRIG — Irrigation fraction used for agricultural purposes; (1–FIRIG) is used for urban water requirements

Data Input from DSS File

If time series data is stored in a DSS file then the following variables should be populated:

REC — Record number that coincides with the data column number for the time series data

PATH — Pathname for the time series record that will be used for data retrieval

```
C*******************************************************************************
C
C                   INTEGRATED WATER FLOW MODEL (IWFM)
C                          *** Version ### ***
C
C*******************************************************************************
C
C        IRRIGATION FRACTIONS FOR PUMPING AND SURFACE WATER DIVERSIONS
C                         for IWFM Simulation
C                              (Unit 27)
C
C
C              Project :  IWFM Version ### Release
C                         California Department of Water Resources
C              Filename:  IRIGFRAC.DAT
C
C*******************************************************************************
C                           File Description
C
C   This data file contains the time series data for the fraction of pumping
C   and surface water diversions to be used for agricultural purposes.
C
C*******************************************************************************
C                         Irrigation Fractions Data Specifications
C
C   NCOLIRF;  Number of columns (or pathnames if DSS files are used) in the
C              irrigation fractions data file
C   NSPIRF ;  Number of time steps to update the irrigation fractions
C              * Enter any number if time-tracking option is on
C   NFQIRF ;  Repetition frequency of the irrigation fractions data
C              * Enter 0 if full time series data is supplied
C              * Enter any number if time-tracking option is on
C   DSSFL  ;  The name of the DSS file for data input (maximum 50 characters);
C              * Leave blank if DSS file is not used for data input
C
C------------------------------------------------------------------------------
C     VALUE               DESCRIPTION
C------------------------------------------------------------------------------
      2                   / NCOLIRF
      1                   / NSPIRF
      1                   / NFQIRF
                          / DSSFL
C-------------------------------------------------------------------------------
C                         Irrigation Fractions Data
C                           (READ FROM THIS FILE)
C
C   List the irrigation fractions data below, if it will not be read from
C   a DSS file (i.e. DSSFL is left blank above).
C
C   ITIRF;  Time
C   FIRIG;  Irrigation fraction
C
C--------------------------------------------------------------------------------
C   ITIRF              FIRIG(1)  FIRIG(2)  FIRIG(3) ...
C--------------------------------------------------------------------------------
   12/31/2100_24:00     0.0       1.0
C-------------------------------------------------------------------------------
C                        Pathnames for Irrigation Fractions Data
C                               (READ FROM DSS FILE)
C
C   List the pathnames for irrigation fractions data below, if it will be read
C   from a DSS file (i.e. DSSFL is specified above).
C
C   REC  ;  Time series record number
C   PATH ;  Pathname for the time series record
C
C--------------------------------------------------------------------------------
C   REC       PATH
C--------------------------------------------------------------------------------
*
*
```

Maximum Lake Elevation Data File Unit 28

This data file contains the time series data for the maximum lake elevations at the modeled lakes. The time-dependent maximum lake elevations at the modeled lakes are associated with each of the data columns through the ICHLMAX variable specified among the lake parameters in the parameter data file (Unit 7). In time tracking simulations the time series maximum lake elevation data can be either listed in this file or in a DSS file. If a DSS file is used for data input, then the name of the DSS file and the pathnames corresponding to each of the time series data are required.

The following is a list of the variables used in this data file:

NCOLHLMX	Total number of time series data columns for maximum lake elevations
FACTHLMX	Conversion factor for maximum lake elevations
NSPHLMX	Number of time steps to update the maximum lake elevations. If time tracking simulation, enter any number.
NFQHLMX	Repetition frequency of the maximum lake elevation data. If time tracking simulation, enter any number.
DSSFL	If the time series data is stored in a DSS file, name of the file. Leave blank if the data is listed in the ASCII text file.

Data Input from ASCII Text File

If the time series data is listed in the same ASCII text file, then the following variables need to be populated. Otherwise, these variables should be commented out

using “C”, “c” or “*”, and the variables in the “Data Input from DSS File” section below should be populated.

ITHLMX	Time. For time tracking simulations use MM/DD/YYYY_hh:mm format, for non-time tracking simulations enter an integer number.
HLMAX	Maximum lake elevation; [L]

Data Input from DSS File

If time series data is stored in a DSS file then the following variables should be populated:

REC	Record number that coincides with the data column number for the time series data
PATH	Pathname for the time series record that will be used for data retrieval

```
C*******************************************************************************
C
C                  INTEGRATED WATER FLOW MODEL (IWFM)
C                         *** Version ### ***
C
C*******************************************************************************
C
C                  MAXIMUM LAKE ELEVATION DATA FILE
C                       for IWFM Simulation
C                            (Unit 28)
C
C
C             Project :  IWFM Version ### Release
C                        California Department of Water Resources
C             Filename:  MAXLKELEV.DAT
C
C*******************************************************************************
C                            File Description
C
C   This data file contains the time series data for the maximum lake elevations
C   at the modeled lakes.
C
C*******************************************************************************
C                        Maximum Lake Elevation Data Specifications
C
C   NCOLHLMX; Total number of time series data columns (or pathanmes if DSS files
C              are used)for maximum lake elevations
C   FACTHLMX; Conversion factor for maximum lake elevations
C   NSPHLMX ; Number of time steps to update the maximum lake elevations
C              * Enter any number if time-tracking option is on
C   NFQHLMX ; Repetition frequency of the maximum lake elevation data
C              * Enter 0 if full time series data is supplied
C              * Enter any number if time-tracking option is on
C   DSSFL  ;  The name of the DSS file for data input (maximum 50 characters);
C              * Leave blank if DSS file is not used for data input
C
C-------------------------------------------------------------------------------
C     VALUE                      DESCRIPTION
C-------------------------------------------------------------------------------
      1                          / NCOLHLMX
      1.0                        / FACTHLMX
      1                          / NSPHLMX
      0                          / NFQHLMX
      TSDATA_IN.DSS              / DSSFL
C-------------------------------------------------------------------------------
C                        Maximum Lake Elevations Data
C                           (READ FROM THIS FILE)
C
C   List the maximum lake elevations data below, if it will not be read from
C   a DSS file (i.e. DSSFL is left blank above).
C
C   ITHLMX ;   Time
C   HLMAX  ;   Maximum lake elevation; [L]
C
C-------------------------------------------------------------------------------
C   ITHLMX    HLMAX(1)  HLMAX(2)  HLMAX(3) ...
C-------------------------------------------------------------------------------
*
*
C-------------------------------------------------------------------------------
C                       Pathnames for Maximum Lake Elevations Data
C                                (READ FROM DSS FILE)
C
C   List the pathnames for maximum lake elevations data below, if it will be read
C   from a DSS file (i.e. DSSFL is specified above).
C
C   REC  ;  Time series record number
C   PATH ;  Pathname for the time series record
C
C---------------------------------------------------------------------------------
C   REC       PATH
C---------------------------------------------------------------------------------
     1        /IWFM/LAKE1/ELEV//1MON/MAX_LAKE_ELEV/
```

Irrigation Water Re-use Factor Data File Unit 29

This data file contains the time series data for the fraction of the return flow from agricultural and urban lands that is re-used. The re-use factors are specified for agricultural urban lands for each subregion. The corresponding data column in this file is associated with each subregion and land use (in terms of agricultural and urban lands) combination through the parameter data file (Unit 7) under "Water Use Parameters" section. If this file is omitted, IWFM assumes that agricultural and urban return flows are not re-used. In time tracking simulations the time series re-use factors data can be either listed in this file or in a DSS file. If a DSS file is used for data input, then the name of the DSS file and the pathnames corresponding to each of the time series data are required.

The following is a list of the variables used in this data file:

NRUF	Number of columns for re-use factors
NSPRUF	Number of time steps to update the re-use factors. If time tracking option, enter any number.
NFQRUF	Repetition frequency of the re-use factor data; a value of zero indicates that a full time series data set is supplied. If time tracking option, enter any number.
DSSFL	If the time series data is stored in a DSS file, name of the file. Leave blank if the data is listed in the ASCII text file.

Data Input from ASCII Text File

If the time series data is listed in the same ASCII text file, then the following variables need to be populated. Otherwise, these variables should be commented out

using “C”, “c” or “*”, and the variables in the “Data Input from DSS File” section below should be populated.

ITRUF	Time. For time tracking simulations use MM/DD/YYYY_hh:mm format, for non-time tracking simulations enter an integer number.
RUF	Fraction of the return flow that is re-used

Data Input from DSS File

If time series data is stored in a DSS file then the following variables should be populated:

REC	Record number that coincides with the data column number for the time series data
PATH	Pathname for the time series record that will be used for data retrieval

```
C*******************************************************************************
C
C                  INTEGRATED WATER FLOW MODEL (IWFM)
C                         *** Version ### ***
C
C*******************************************************************************
C
C              IRRIGATION WATER RE-USE FACTOR DATA FILE
C                       for IWFM Simulation
C                            (Unit 29)
C
C
C             Project :  IWFM Version ### Release
C                        California Department of Water Resources
C             Filename:  RUF.DAT
C
C*******************************************************************************
C                               File Description
C
C   This data file contains the factors for the re-use of irrigation water on a
C   time-series basis for each subregion for the model simulation period. It is
C   assumed that only the surface runoff (as opposed to tile drainage) from the
C   fields can be allocated for re-use.
C
C*******************************************************************************
C            Irrigation Water Re-use Factor Data Specifications
C
C   NRUF   ;  Number of columns (or pathnames if DSS files are used) for
C              re-use factors
C   NSPRUF ;  Number of time steps to update the re-use factors
C              * Enter any number if time-tracking option is on
C   NFQRUF ;  Repetition frequency of the re-use factor data
C              * Enter 0 if full time series data is supplied
C              * Enter any number if time-tracking option is on
C   DSSFL  ;  The name of the DSS file for data input (maximum 50 characters);
C              * Leave blank if DSS file is not used for data input
C
C-------------------------------------------------------------------------------
C    VALUE                      DESCRIPTION
C-------------------------------------------------------------------------------
     4                          / NRUF
     1                          / NSPRUF
     1                          / NFQRUF
                                / DSSFL
C-------------------------------------------------------------------------------
C                      Irrigation Water Re-use Factors
C                          (READ FROM THIS FILE)
C
C   List the irrigation water re-use factors below, if it will not be read from
C   a DSS file (i.e. DSSFL is left blank above).
C
C   ITRUF;   Time
C   RUF  ;   Irrigation water re-use factor. It is defined as the ratio of the
C            surface runoff that is re-used to the total surface runoff; [dimensionless]
C
C-------------------------------------------------------------------------------
C    ITRUF          RUF(1)   RUF(2)   RUF(3) ....
C-------------------------------------------------------------------------------
  12/31/2200_24:00   0.00     0.00     0.73     0.83
C-------------------------------------------------------------------------------
C                      Pathnames for Irrigation Water Re-use Factors
C                               (READ FROM DSS FILE)
C
C   List the pathnames for irrigation water re-use factors below, if it will be read
C   from a DSS file (i.e. DSSFL is specified above).
C
C   REC  ;  Time series record number
C   PATH ;  Pathname for the time series record
C
C----------------------------------------------------------------------------------------
C   REC       PATH
C----------------------------------------------------------------------------------------
*
*
```

Aquifer Parameter Over-write Data File Unit 30

This data file can be used to over-write selected parameter values at selected groundwater nodes. IWFM initially assigns parameter values to groundwater nodes through the information specified in the parameter data file (Unit 7). Sometimes it becomes necessary to modify some of the parameter values at selected groundwater nodes. One such situation is when IWFM is used in conjunction with an automated calibration program such as PEST (Paramater ESTimation program). PEST can automatically generate parameter values at specific groundwater nodes and this file can be used to over-write the previously specified values at these nodes. This file also allows the user to by-pass the need to generate excessive numbers of parametric grid groups when only a few parameter values at a few groundwater nodes need to be modified. The following variables are used in this data file:

NWRITE	Total number of groundwater nodes at which previously defined parameter values will be over-written
FKH	Conversion factor for the spatial component for the unit of horizontal hydraulic conductivity
FS	Conversion factor for specific storage coefficient
FN	Weighting factor for specific yield value
FV	Conversion factor for the spatial component for the unit of aquitard vertical hydraulic conductivity
FL	Conversion factor for the spatial component for the unit of aquifer vertical hydraulic conductivity
FSCE	Conversion factor for elastic storage coefficient

FSCI	Conversion factor for inelastic storage coefficient
TUNITKH	Time unit of horizontal hydraulic conductivity. This should be one of the units recognized by HEC-DSS that are listed in the Main Control File.
TUNITV	Time unit of aquitard vertical conductivity. This should be one of the units recognized by HEC-DSS that are listed in the Main Control File.
TUNITL	Time unit of aquifer vertical conductivity. This should be one of the units recognized by HEC-DSS that are listed in the Main Control File.
ID	Groundwater node number for which one or more parameter values will be modified
LAYER	Aquifer layer in which groundwater node ID resides
PKH	Hydraulic conductivity that will over-write the previously defined value (enter −1.0 if hydraulic conductivity at this node will not be modified); [L/T]
PS	Specific storage that will over-write the previously defined value (enter −1.0 if specific storage at this node will not be modified); [1/L]
PN	Specific yield that will over-write the previously defined value (enter −1.0 if specific yield at this node will not be modified); [L/L]

PV	Aquitard vertical hydraulic conductivity that will over-write the previously defined value (enter −1.0 if aquitard vertical hydraulic conductivity at this node will not be modified); [L/T]
PL	Aquifer vertical hydraulic conductivity that will over-write the previously defined value (enter −1.0 if aquifer vertical hydraulic conductivity at this node will not be modified); [L/T]
SCE	Elastic storage coefficient that will over-write the previously defined value (enter −1.0 if elastic storage coefficient at this node will not be modified); [1/L]
SCI	Inelastic storage coefficient that will over-write the previously defined value (enter −1.0 if inelastic storage coefficient at this node will not be modified); [1/L]

```
C*******************************************************************************
C
C                   INTEGRATED WATER FLOW MODEL (IWFM)
C                          *** Version ### ***
C
C*******************************************************************************
C
C                AQUIFER PARAMETER OVER-WRITE DATA FILE
C                         for IWFM Simulation
C                             (Unit 30)
C
C
C              Project :  IWFM Version ### Release
C                         California Department of Water Resources
C              Filename:  OVERWRITE.DAT
C
C*******************************************************************************
C                            File Description
C
C   This data file contains node and layer numbers, and associated parameter
C   values to over-write values specified in the parameter data file (Unit 7).
C
C*******************************************************************************
C                Over-writing Parameter Value Data Specifications
C
C   NWRITE; Total number of groundwater nodes at which previously defined
C             parameter values will be over-written.
C
C-------------------------------------------------------------------------------
C   VALUE                        DESCRIPTION
C-------------------------------------------------------------------------------
    4179                         / NWRITE
C-------------------------------------------------------------------------------
C
C         Conversion factors for over-writing parameter values
C
C   FKH    ;  Conversion factor for horizontal hydraulic conductivity
C              It is used to convert only the spatial component of the unit;
C              DO NOT include the conversion factor for time component of the unit.
C              * e.g. Unit of hydraulic conductivity listed in this file = FT/MONTH
C                     Consistent unit used in simulation                 = IN/DAY
C                     Enter FKH (FT/MONTH -> IN/MONTH)                   = 8.33333E-02
C                      (conversion of MONTH -> DAY is performed automatically)
C   FS     ;  Conversion factor for specific storage coefficient
C   FN     ;  Weighting factor for specific yield value
C   FV     ;  Conversion factor for aquitard vertical hydraulic conductivity
C              It is used to convert only the spatial component of the unit;
C              DO NOT include the conversion factor for time component of the unit.
C              * e.g. Unit of hydraulic conductivity listed in this file = FT/MONTH
C                     Consistent unit used in simulation                 = IN/DAY
C                     Enter FKH (FT/MONTH -> IN/MONTH)                   = 8.33333E-02
C                      (conversion of MONTH -> DAY is performed automatically)
C   FL     ;  Conversion factor for aquifer vertical hydraulic conductivity
C              It is used to convert only the spatial component of the unit;
C              DO NOT include the conversion factor for time component of the unit.
C              * e.g. Unit of hydraulic conductivity listed in this file = FT/MONTH
C                     Consistent unit used in simulation                 = IN/DAY
C                     Enter FKH (FT/MONTH -> IN/MONTH)                   = 8.33333E-02
C                      (conversion of MONTH -> DAY is performed automatically)
C   FSCE   ;  Conversion factor for elastic storage coefficient
C   FSCI   ;  Conversion factor for inelastic storage coefficient
C   TUNITKH;  Time unit of horizontal hydraulic conductivity.  This should be one of the units
C              recognized by HEC-DSS that are listed in the Main Control File.
C   TUNITV ;  Time unit of aquitard vertical conductivity.  This should be one of the units
C              recognized by HEC-DSS that are listed in the Main Control File.
C   TUNITL ;  Time unit of aquifer vertical conductivity.  This should be one of the units
C              recognized by HEC-DSS that are listed in the Main Control File.
C
C-------------------------------------------------------------------------
C  FKH         FS          FN         FV        FL       FSCE        FSCI
C-------------------------------------------------------------------------
   1.00        1.00        1.00       1.00      1.00     1.00        1.00
C----------------------------------------------------------------------------------------------
C   VALUE              DESCRIPTION
C----------------------------------------------------------------------------------------------
    1mon               / TUNITKH
    1mon               / TUNITV
    1mon               / TUNITL
C-------------------------------------------------------------------------
C
C   The following lists the groundwater nodenumber, aquifer layer number and the
C    associated parameter values that will over-write the previously defined
C    values.
C    *** Enter -1.0 not to over-write the previously set values ***
C
C
C   ID   ;   Groundwater node number
C   LAYER;   Aquifer layer
C   PKH  ;   Hydraulic conductivity; [L/T]
C   PS   ;   Specific storage; [1/L]
```

```
C   PN   ;   Specific yield; [L/L]
C   PV   ;   Aquitard vertical hydraulic conductivity; [L/T]
C   PL   ;   Aquifer vertical hydraulic conductivity; [L/T]
C   SCE  ;   Elastic storage coefficient (Use SCE*DC if DC=0); [1/L]
C   SCI  ;   Inelastic storage coefficient (Use SCI*DC if DC=0); [1/L]
C            *Note* The above land subsidence parameters are only for interbed
C   4.3.             layers (i.e. clay layers)
C
C-----------------------------------------------------------------------------------------------
C                Hydr.        Spec.          Spec.    Aquitard  Aquifer   Elastic   Inelastic
C                cond.        Stor.          Yld.       Vert.K  Vert.K   Stg. Coef. Stg. Coef.
C  ID   LAYER    PKH          PS             PN           PV       PL       SCE        SCI
C-----------------------------------------------------------------------------------------------
     1     1   2404.766   9.9999997E-06  2.0151161E-02  -1.00   334.3762   -1.00      -1.00
     1     2   1052.881   5.0065097E-05  3.3468835E-02  -1.00   240.6059   -1.00      -1.00
     1     3   9706.813   1.0849720E-04  5.8463603E-02  -1.00   214.9347   -1.00      -1.00
     2     1   2407.003   1.0000001E-05  1.9952139E-02  -1.00   331.9574   -1.00      -1.00
     2     2   1044.410   5.0159750E-05  3.4741677E-02  -1.00   239.1580   -1.00      -1.00
     2     3   9612.228   1.1174077E-04  6.1085913E-02  -1.00   215.6135   -1.00      -1.00
     .     .      .            .              .           .        .        .          .
     .     .      .            .              .           .        .        .          .
     .     .      .            .              .           .        .        .          .
  1392     2   1393.980   1.9578732E-04  7.3446646E-02  -1.00   2.911047   -1.00      -1.00
  1392     3   680.7024   1.4334776E-04  5.9957355E-02  -1.00   7.285010   -1.00      -1.00
  1393     1   2391.534   9.9999997E-06  0.1486767      -1.00   4.609168   -1.00      -1.00
  1393     2   1437.810   2.3690333E-04  8.9009784E-02  -1.00   3.107419   -1.00      -1.00
  1393     3   759.8795   1.6385839E-04  9.4242930E-02  -1.00   6.028072   -1.00      -1.00
```

Output Files

IWFM generates ASCII, DSS and binary files based on the user preference in order to view and analyze the simulation results. To generate an output file, it is only necessary to specify a name for the file in the control input file (Unit 5). Omitting the name for an output file will suppress the generation of that file. Generation of some output files is dependent on the system being modeled. For instance, if a groundwater system with a single aquifer layer is modeled, defining a file name for layer vertical flow output file (Unit 49) will fail to generate the required file since there are no vertical flows being calculated.

The following sections describe each of the output files in detail.

Standard ASCII Output (SimulationMessages.out)

This file provides the user with information that was processed in the simulation portion of IWFM. The user is encouraged to check the contents of this file after every run. The following list indicates the information available in this output file:

- Project title (specified in Unit 5)
- Date and time of run, which is determined internally within the program
- List of input files read in the pre-processing program and the associated date that the input files were modified. Output file names specified in Unit 5 are written to this file as well
- Various warning messages and errors

- Aquifer parameters depending on the option set by the user in the main input file (Unit 5)
- Convergence information on the iterative procedures at each time step
- Total CPU time consumed by the execution of the Simulation program

```
*********************************************************************************************
                                                   IWFM
                                             Version ### Release
                                                    DWR
*********************************************************************************************

THIS RUN IS MADE ON 01/23/2007 AT 14:04:34

THE FOLLOWING FILES ARE USED IN THIS SIMULATION:
 2
 3
 4      12/20/2006  08:17:55       OUTPUT1.BIN
 5
 6
 7      12/20/2006  08:17:55       PARAMETER.DAT
 8      12/20/2006  08:17:55       BOUND.DAT
 9      12/20/2006  08:17:55       BOUNDTSD.DAT
 10     12/20/2006  08:17:55       PRINT.DAT
 11     01/23/2007  13:10:41       INIT.DAT
 12     07/31/2006  11:44:53       SUPADJ.DAT
 13     07/31/2006  11:44:51       LANDUSE.DAT
 14     07/31/2006  11:44:51       CROPAREA.DAT
 15     12/20/2006  08:17:55       PRECIP.DAT
 16     12/20/2006  08:17:55       ET.DAT
 17     07/31/2006  11:44:53       TILEDRN.DAT
 18     07/31/2006  11:44:53       URBSPEC.DAT
 19
 20     07/31/2006  11:44:53       URBDEMAND.DAT
 21     07/31/2006  11:44:53       INFLOW.DAT
 22     07/31/2006  11:44:51       CROPDEMAND.DAT
 23     12/20/2006  08:17:55       PUMPSPEC.DAT
 24     12/20/2006  08:17:55       PUMP.DAT
 25     07/31/2006  11:44:51       DIVERSPEC.DAT
 26     07/31/2006  11:44:51       DIVER.DAT
 27     12/20/2006  08:17:55       IRIGFRAC.DAT
 28     07/31/2006  11:44:52       MAXLKELEV.DAT
 29     07/31/2006  11:44:53       RUF.DAT
 30
 31                                ZBUDGET.BIN
 32                                SMWSHED.BIN
 33                                SUBGRP.BIN
 34                                DIVERDTL.BIN
 35                                REACH.BIN
 36                                LAKE.BIN
 37                                LWU.BIN
 38                                STRM.BIN
 39                                SOIL.BIN
 40                                GW.BIN
 41                                SUBSIDENCE.OUT
 42                                VIRCROP.OUT
 43                                FACEFLOW.OUT
 44                                BNDFLX.OUT
 45                                TDRN.OUT
 46                                STRM.HYD
 47                                GW.HYD
 48                                GWHEAD.HYD
 49                                VERTFLOW.OUT
 50
 51
 52                                FNRESULTS.OUT
NOTE: SURFACE WATER DIVERSION WAS ADJUSTED, PUMPING WAS NOT ADJUSTED.

--------------------------------------------------
TIME STEP       1 AT       1.00 DAYS
--------------------------------------------------

                         *** SUPPLY ADJUSTMENT ITERATION:     1 ***
   ITER      CONVERGENCE         MAX.DIFF    VARIABLE       PUMP.CONV.    DRY LOCATION
   --------------------------------------------------------------------------
      1      195.230          21.0129            478      0.00000             0()
      2      5.83998          3.54401            289      0.00000             0()
      3      3.68873         0.660095             24      0.00000             0()
      4     0.205938         0.373303E-01         24      0.00000             0()
      5     0.404192E-04     0.201223E-04         21      0.00000             0()

                         *** SUPPLY ADJUSTMENT ITERATION:     2 ***
   ITER      CONVERGENCE         MAX.DIFF    VARIABLE       PUMP.CONV.    DRY LOCATION
   --------------------------------------------------------------------------
      1      195.063          21.0129            478      0.00000             0()
      2      5.43178          1.46387             22      0.00000             0()
      3     0.435922         0.179985            289      0.00000             0()
      4     0.286186E-01     0.518918E-02         24      0.00000             0()
      5     0.566625E-05     0.275926E-05         21      0.00000             0()
--------------------------------------------------
TIME STEP       2 AT       2.00 DAYS
--------------------------------------------------
      .        .                 .                  .         .                 .
      .        .                 .                  .         .                 .
**************************************************
 TOTAL RUN TIME:    6 MINUTES 15.59 SECONDS
**************************************************
```

Subsidence Output File   Unit 41

The subsidence output file includes the simulated subsidence values at aquifer layers and nodes specified by the user in Unit 10. The layer and node numbers for which subsidence output are desired are specified by the user. If print-out at locations other than finite element nodes are desired, then IWFM prints out the element number where the x-y coordinate lies in. If total subsidence over all the aquifer layers is desired, then a value of zero appears for the layer number at the heading of this file. A negative subsidence value indicates that interbed thickness is decreasing due to falling groundwater heads, while a positive subsidence indicates expanding interbed thickness due to rising groundwater heads.

If the subsidence values are desired to be printed out to a DSS file, a file name with the extension ".DSS" should be supplied. The following pathname parts are used for output to a DSS file:

Part A:

IWFM

Part B:

One of the following depending on the output data:

i. *ID*:L*XXX*:GW*YYY* (if subsidence are printed for nodes; *ID* is the subsidence print-out number listed sequentially in the print control file (Unit 10), *XXX* is the aquifer layer number and YYY is the groundwater node number)

ii. *ID*:L*XXX*:E*YYY* (if subsidence values are printed for x-y coordinates; *ID* is the subsidence print-out number listed sequentially in the print control file (Unit 10), *XXX* is the aquifer layer number and *YYY* is the element number that the x-y coordinate falls into)

Part C:

TOTAL_CHANGE_THICK

Part D:

Start date of the time series depending on the time step used in the Simulation and the value of the BDT variable (starting date and time of simulation period) set in the Simulation main control input file

Part E:

Time step used in the Simulation

Part F:

SUBSIDENCE

```
*                                               ****************************************
*                                               *   TOTAL CHANGE IN INTERBED THICKNESS *
*                                               *              (UNIT=FEET)             *
*                                               ****************************************
*                       LAYER     0            0             0             0             0
*                        NODE   168          169           170           171           178
*        TIME
10/31/1921 24:00             0.0000       0.0000        0.0000        0.0000        0.0000
11/30/1921 24:00             0.0000       0.0000        0.0000        0.0000        0.0000
12/31/1921 24:00             0.0000       0.0000        0.0000        0.0000        0.0000
01/31/1922 24:00             0.0000       0.0000        0.0000        0.0000        0.0000
02/28/1922 24:00             0.0000       0.0000        0.0000        0.0000       -0.0001
03/31/1922 24:00             0.0000       0.0000        0.0000        0.0000       -0.0001
04/30/1922 24:00             0.0000       0.0002        0.0002        0.0000       -0.0001
05/31/1922 24:00             0.0000       0.0002        0.0002        0.0000       -0.0001
06/30/1922 24:00             0.0000       0.0002        0.0003        0.0001       -0.0001
07/31/1922 24:00             0.0001       0.0003        0.0003        0.0001       -0.0001
08/31/1922_24:00             0.0001       0.0003        0.0003        0.0001       -0.0001
     .                          .            .             .             .             .
     .                          .            .             .             .             .
     .                          .            .             .             .             .
06/30/2007 24:00             0.0033       0.0049        0.0036        0.0005       -0.0001
07/31/2007 24:00             0.0034       0.0050        0.0037        0.0005       -0.0001
08/31/2007 24:00             0.0034       0.0050        0.0036        0.0005       -0.0001
09/30/2007 24:00             0.0033       0.0048        0.0034        0.0003       -0.0001
10/31/2007 24:00             0.0032       0.0047        0.0033        0.0003       -0.0001
11/30/2007 24:00             0.0032       0.0047        0.0033        0.0003       -0.0001
12/31/2007 24:00             0.0032       0.0046        0.0033        0.0003       -0.0001
01/31/2008 24:00             0.0032       0.0046        0.0032        0.0002       -0.0001
02/29/2008 24:00             0.0032       0.0046        0.0033        0.0003       -0.0001
03/31/2008 24:00             0.0032       0.0046        0.0032        0.0003       -0.0001
04/30/2008 24:00             0.0033       0.0049        0.0035        0.0005       -0.0001
05/31/2008 24:00             0.0033       0.0049        0.0035        0.0004       -0.0001
06/30/2008 24:00             0.0034       0.0050        0.0036        0.0005       -0.0001
07/31/2008 24:00             0.0034       0.0051        0.0037        0.0005       -0.0001
08/31/2008 24:00             0.0034       0.0050        0.0036        0.0005        0.0000
09/30/2008 24:00             0.0033       0.0049        0.0035        0.0004        0.0000
10/31/2008 24:00             0.0033       0.0048        0.0034        0.0003        0.0000
11/30/2008 24:00             0.0032       0.0047        0.0033        0.0003        0.0000
12/31/2008 24:00             0.0032       0.0047        0.0033        0.0003        0.0000
01/31/2009 24:00             0.0032       0.0047        0.0033        0.0003        0.0000
02/28/2009 24:00             0.0032       0.0046        0.0033        0.0003        0.0000
03/31/2009 24:00             0.0032       0.0046        0.0032        0.0003        0.0000
04/30/2009 24:00             0.0033       0.0048        0.0035        0.0005        0.0000
05/31/2009 24:00             0.0033       0.0049        0.0035        0.0004        0.0000
06/30/2009 24:00             0.0034       0.0050        0.0036        0.0005        0.0000
07/31/2009 24:00             0.0034       0.0051        0.0037        0.0005        0.0000
08/31/2009 24:00             0.0034       0.0051        0.0037        0.0005        0.0000
09/30/2009 24:00             0.0033       0.0049        0.0035        0.0004        0.0000
```

Virtual Crop Characteristics Unit 42

This output file is generated when crop characteristics that are weighted averaged for each subregion are required to be printed. For each subregion average values for the root zone depth, minimum soil moisture requirement, crop evapotranspiration (ET_c) and irrigation efficiency are printed out at each simulation time step. The root zone depth and ET_c are printed in the units specified by the user in control input file (Unit 5)

If the virtual crop characteristics are desired to be printed out to a DSS file, a file name with the extension ".DSS" should be supplied. The following pathname parts are used for output to a DSS file:

Part A:

IWFM

Part B:

SR*XXX* where *XXX* is the subregion number

Part C:

One of the following, depending on the output data:

i. *DEPTH* (for virtual crop root zone depth)

ii. *FRACTION* (for virtual crop minimum soil moisture requirement)

iii. *EVAPOTR* (for virtual crop ET_c)

iv. *FRACTION* (for virtual crop irrigation efficiency)

Part D:

Start date of the time series depending on the time step used in the Simulation and the value of the BDT variable (starting date and time of simulation period) set in the Simulation main control input file

Part E:

Time step used in the Simulation

Part F:

One of the following, depending on the output data:

i. *VIRTUAL_CROP_ROOT_ZONE* (for virtual crop root zone depth)

ii. *VIRTUAL_CROP_MIN_SOIL_MOIST_REQ* (for virtual crop minimum soil moisture requirement)

iii. *VIRTUAL_CROP_ET* (for virtual crop ET_c)

iv. *VIRTUAL_CROP_IRRIGATION_EFF* (for virtual crop irrigation efficiency)

```
*                                         **************************************
*                                         *    VIRTUAL CROP CHARACTERISTICS    *
*                                         *         FOR EACH SUBREGION         *
*                                         **************************************
*            REGION                                 1                        1                         1                          1
*                                    Root Zone Depth    Min. Soil Moist. Req.  Crop Evapotranspiration     Irrigation Efficiency
*         TIME                            (FEET)           (dimensionless)             (FEET)               (dimensionless)
10/31/1921_24:00                             2.46                     0.49                     0.28                     0.69
11/30/1921_24:00                             2.46                     0.33                     0.13                     0.69
12/31/1921_24:00                             2.46                     0.00                     0.08                     0.00
01/31/1922_24:00                             2.46                     0.00                     0.08                     0.00
02/28/1922_24:00                             2.46                     0.00                     0.15                     0.00
03/31/1922_24:00                             2.46                     0.66                     0.25                     0.69
04/30/1922_24:00                             2.46                     0.98                     0.36                     0.69
05/31/1922_24:00                             2.46                     0.99                     0.47                     0.69
06/30/1922_24:00                             2.46                     0.84                     0.59                     0.69
07/31/1922_24:00                             2.46                     0.68                     0.65                     0.69
08/31/1922_24:00                             2.46                     0.67                     0.55                     0.69
09/30/1922_24:00                             2.46                     0.65                     0.43                     0.69
10/31/1922_24:00                             2.46                     0.49                     0.28                     0.69
11/30/1922_24:00                             2.46                     0.33                     0.13                     0.69
12/31/1922_24:00                             2.46                     0.00                     0.08                     0.00
01/31/1923_24:00                             2.46                     0.00                     0.08                     0.00
02/28/1923_24:00                             2.46                     0.00                     0.15                     0.00
03/31/1923_24:00                             2.46                     0.66                     0.25                     0.69
04/30/1923_24:00                             2.46                     0.98                     0.36                     0.69
05/31/1923_24:00                             2.46                     0.99                     0.47                     0.69
06/30/1923_24:00                             2.46                     0.84                     0.59                     0.69
07/31/1923_24:00                             2.46                     0.68                     0.65                     0.69
08/31/1923_24:00                             2.46                     0.67                     0.55                     0.69
09/30/1923_24:00                             2.46                     0.65                     0.43                     0.69
```

Element Face Flow Output File Unit 43

This output file is generated when simulated flow at specified element faces are required to be printed. The element faces and aquifer layer numbers for which flow values are printed are specified by the user in print control file (Unit 10). The flow rates are printed in the units specified by the user in control input file (Unit 5) for every time step of the simulation period. The element numbers that interface at the specified face are listed at the top of the output file in the format *EXXX-EYYY*, where *XXX* and *YYY* are the element numbers. If the element face is located at the model boundary, then *EXXX* is reported as *E0*. If the flow rate is positive then the flow at the element face is towards the element listed first (i.e. towards *EXXX*); if the flow rate is negative then the flow at the element face is towards the element listed second (i.e. towards *EYYY*).

If the element face flow values are desired to be printed out to a DSS file, a file name with the extension ".DSS" should be supplied. The following pathname parts are used for output to a DSS file:

Part A:

IWFM

Part B:

L*ZZZ*:E*XXX*-E*YYY* where *ZZZ* is the aquifer layer number, *XXX* is the first element number interfacing at the face, and *YYY* is the second element number

Part C:

FLOW

Part D:

Start date of the time series depending on the time step used in the Simulation and the value of the BDT variable (starting date and time of simulation period) set in the Simulation main control input file

Part E:

Time step used in the Simulation

Part F:

ELEMENT_FACE_FLOW

```
*                                         ***************************************
*                                         *          ELEMENT FACE FLOW          *
*                                         *            (UNIT=AC-FT)             *
*                                         ***************************************
*               LAYER               1               2               3               1
*                FACE       E791-E795       E791-E795       E791-E795           E0-E1
*        TIME
10/31/1921_24:00               233.50          177.25            0.56            0.00
11/30/1921_24:00               121.43           90.52            0.56            0.00
12/31/1921_24:00               126.47           91.03            0.57            0.00
01/31/1922_24:00               109.06           91.68            0.57            0.00
02/28/1922_24:00               120.64           92.53            0.57            0.00
03/31/1922_24:00                65.13           94.70            0.58            0.00
04/30/1922_24:00               -56.11           93.70            0.58            0.00
05/31/1922_24:00              -176.39           94.26            0.58            0.00
06/30/1922_24:00              -109.11           96.46            0.59            0.00
07/31/1922_24:00               -28.06           97.02            0.60            0.00
08/31/1922_24:00                76.86          121.41            0.60            0.00
09/30/1922_24:00               112.13           97.79            0.60            0.00
10/31/1922_24:00               140.59           99.28            0.61            0.00
11/30/1922_24:00               156.17          101.08            0.62            0.00
12/31/1922_24:00               131.83          103.01            0.63            0.00
01/31/1923_24:00               124.50          104.92            0.65            0.00
02/28/1923_24:00               144.29          106.71            0.66            0.00
03/31/1923_24:00                55.08          111.46            0.66            0.00
04/30/1923_24:00               -53.07          109.04            0.67            0.00
05/31/1923_24:00              -154.43          110.38            0.68            0.00
06/30/1923_24:00               -59.59          113.14            0.69            0.00
      .                           .               .               .               .
      .                           .               .               .               .
      .                           .               .               .               .
      .                           .               .               .               .
09/30/1930_24:00               436.35          138.10            0.84            0.00
10/31/1930_24:00               438.48          140.41            0.86            0.00
11/30/1930_24:00               440.30          143.07            0.87            0.00
12/31/1930_24:00               441.75          145.88            0.89            0.00
01/31/1931_24:00               371.70          148.66            0.91            0.00
02/28/1931_24:00               444.66          151.26            0.93            0.00
03/31/1931_24:00                -1.51          145.56            0.89            0.00
04/30/1931_24:00               194.25          147.78            0.90            0.00
05/31/1931_24:00               227.11          150.39            0.91            0.00
06/30/1931_24:00               291.92          206.68            0.85            0.00
07/31/1931_24:00               415.62          219.91            0.80            0.00
08/31/1931_24:00               450.09          197.10            0.77            0.00
09/30/1931_24:00               484.84          147.63            0.77            0.00
```

Boundary Flux Output File Unit 44

This output file is generated when simulated flow at the groundwater boundary nodes are required to be printed. The groundwater node and aquifer layer numbers for which flow values are printed are specified by the user in print control file (Unit 10). The flow rates are printed in the units specified by the user in control input file (Unit 5) for every time step of the simulation period. A negative flow value represents outflow from the model area, and a positive value represents an inflow into the model area.

If the boundary flow values are desired to be printed out to a DSS file, a file name with the extension ".DSS" should be supplied. The following pathname parts are used for output to a DSS file:

Part A:

IWFM

Part B:

L*ZZZ*:GW*XXX* where *ZZZ* is the aquifer layer number, *XXX* is the groundwater node number

Part C:

FLOW

Part D:

Start date of the time series depending on the time step used in the Simulation and the value of the BDT variable (starting date and time of simulation period) set in the Simulation main control input file

Part E:

Time step used in the Simulation

Part F:

BOUNDARY_NODE_FLOW

```
*                                        ********************************************
*                                        *             BOUNDARY FLOW                *
*                                        *              (UNIT=AC-FT)                *
*                                        * [NOTE: INFLOW TO THE BASIN IS POSITIVE]  *
*                                        ********************************************
*               LAYER             1             1             1             1             1             1
*                NODE           435           451           460           463           473           475
*        TIME
10/31/1921_24:00            -399.57       -516.08       -420.01       -509.60       -389.90       -276.87
11/30/1921_24:00            -326.65       -355.41       -366.47       -301.16       -224.97        -64.41
12/31/1921_24:00            -289.29       -297.24       -320.69       -326.56       -274.25       -231.77
01/31/1922_24:00            -328.24       -338.35       -311.73       -389.64       -338.59       -361.52
02/28/1922_24:00            -313.12       -286.25       -394.69       -299.31       -232.86       -153.19
03/31/1922_24:00            -275.79       -247.78       -319.95       -214.82       -135.93        -33.21
04/30/1922_24:00            -264.61       -221.95       -261.04       -165.59        -76.50         28.35
05/31/1922_24:00            -371.96       -292.24       -284.77       -296.43       -214.53       -240.87
06/30/1922_24:00            -308.81       -293.54       -236.83       -304.59       -268.18       -369.21
07/31/1922_24:00            -164.90       -261.67       -198.62       -239.45       -242.11       -280.61
08/31/1922_24:00            -123.78       -246.60       -196.72       -204.27       -207.61       -181.80
09/30/1922_24:00            -169.78       -250.10       -234.31       -198.68       -165.01        -75.68
10/31/1922_24:00            -155.49       -239.69       -223.61       -187.58       -136.45        -56.91
11/30/1922_24:00            -187.10       -268.61       -235.40       -236.25       -179.53       -149.79
12/31/1922_24:00            -292.93       -334.48       -278.71       -355.62       -303.55       -376.68
01/31/1923_24:00            -372.04       -401.90       -493.96       -478.66       -451.25       -588.30
02/28/1923_24:00            -266.23       -305.53       -355.21       -284.25       -259.55       -188.00
03/31/1923_24:00            -252.96       -296.84       -319.70       -276.76       -242.56       -192.71
04/30/1923_24:00             772.03        487.36        610.48        784.93        535.35        448.91
05/31/1923_24:00              99.96        -29.09         31.57         86.76        -84.57        -93.48
06/30/1923_24:00            -232.22       -341.51       -261.01       -356.12       -456.53       -509.08
07/31/1923_24:00            -216.26       -325.23       -265.84       -326.47       -415.36       -407.59
       .                          .             .             .             .             .             .
       .                          .             .             .             .             .             .
       .                          .             .             .             .             .             .
       .                          .             .             .             .             .             .
09/30/1929_24:00             -74.59       -251.38       -398.55       -311.36       -508.91       -311.78
10/31/1929_24:00             -43.76       -220.08       -377.14       -271.70       -442.54       -282.59
11/30/1929_24:00             -35.84       -211.92       -368.61       -265.93       -421.42       -308.39
12/31/1929_24:00            -299.23       -473.69       -541.51       -723.76       -905.95      -1340.36
01/31/1930_24:00            -422.66       -561.38       -604.47       -865.43      -1133.35      -1354.20
02/28/1930_24:00            -261.33       -341.41       -594.03       -444.98       -674.44       -430.10
03/31/1930_24:00            -213.66       -277.91       -497.97       -342.79       -526.90       -336.88
04/30/1930_24:00              24.15        -90.65       -298.63        -86.08       -294.66       -125.49
05/31/1930_24:00             780.49        435.11        202.74        669.42        467.43        529.81
06/30/1930_24:00              -7.41       -266.40       -390.45       -390.01       -620.68       -801.72
07/31/1930_24:00             -14.11       -250.19       -378.64       -352.75       -634.15       -642.72
08/31/1930_24:00              49.66       -191.56       -340.93       -290.06       -540.86       -442.35
09/30/1930_24:00             -49.08       -220.39       -405.30       -281.13       -505.72       -292.20
10/31/1930_24:00             -35.30       -197.85       -391.37       -249.67       -446.68       -270.63
11/30/1930_24:00             -64.01       -225.37       -405.81       -296.62       -484.51       -436.86
12/31/1930_24:00            -166.72       -349.29       -478.09       -504.33       -701.18       -860.51
01/31/1931_24:00            -208.63       -369.38       -679.26       -527.71       -754.21       -775.75
02/28/1931_24:00            -136.91       -268.69       -630.96       -340.67       -556.82       -338.45
03/31/1931_24:00            -128.99       -252.23       -499.00       -324.42       -528.25       -409.83
04/30/1931_24:00             194.45        -69.60       -212.76       -113.78       -429.06       -569.94
05/31/1931_24:00            -107.51       -333.96       -463.15       -471.28       -760.04       -804.14
06/30/1931_24:00            -124.46       -353.02       -452.29       -538.87       -809.90       -859.91
07/31/1931_24:00             107.94       -340.19       -404.25       -464.39       -819.29       -758.80
08/31/1931_24:00              17.81       -333.54       -447.97       -450.26       -763.44       -645.46
09/30/1931_24:00             -35.38       -233.99       -437.98       -306.70       -567.62       -329.26
```

Tile Drain Hydrograph Output Unit 45

This output file is generated when simulated flow at the tile drains and/or subsurface irrigation locations are required to be printed. The corresponding groundwater node numbers for which flow values are printed are specified by the user in print control file (Unit 10). The flow rates are printed in the units specified by the user in control input file (Unit 5) for every time step of the simulation period. A negative flow value represents tile drain outflow at the specified groundwater node, and a positive value represents subsurface irrigation inflow.

If the tile drain/subsurface irrigation flow values are desired to be printed out to a DSS file, a file name with the extension ".DSS" should be supplied. The following pathname parts are used for output to a DSS file:

Part A:

IWFM

Part B:

GW*XXX* where *XXX* is the groundwater node number

Part C:

FLOW

Part D:

Start date of the time series depending on the time step used in the Simulation and the value of the BDT variable (starting date and time of simulation period) set in the Simulation main control input file

Part E:

Time step used in the Simulation

Part F:

TILE_DRAIN_HYDROGRAPHS

```
*                                             *************************************************
*                                             *  TILE DRAIN/SUBSURFACE IRRIGATION HYDROGRAPH  *
*                                             *                  (UNIT=AC-FT)                  *
*                                             *      [(+): SUBSURFACE IRRIGATION INFLOW]      *
*                                             *      [(-): TILE DRAIN OUTFLOW          ]      *
*                                             *************************************************
*                           NODES
*         TIME                861         862         863         670         682
10/31/1921_24:00             0.00        0.00       -0.03       -0.39        0.00
11/30/1921_24:00             0.00        0.00       -0.04       -0.46        0.00
12/31/1921_24:00             0.00        0.00       -0.05       -0.52        0.00
01/31/1922_24:00             0.00        0.00       -0.05       -0.57        0.00
02/28/1922_24:00             0.00        0.00       -0.05       -0.61        0.00
03/31/1922_24:00             0.00        0.00       -0.06       -0.65        0.00
04/30/1922_24:00             0.00        0.00       -0.06       -0.69        0.00
05/31/1922_24:00             0.00        0.00       -0.06       -0.74        0.00
06/30/1922_24:00             0.00        0.00       -0.06       -0.78        0.00
07/31/1922_24:00             0.00        0.00       -0.06       -0.82        0.00
08/31/1922_24:00             0.00        0.00       -0.06       -0.84        0.00
09/30/1922_24:00             0.00        0.00       -0.07       -0.87        0.00
10/31/1922_24:00             0.00        0.00       -0.07       -0.89        0.00
11/30/1922_24:00             0.00        0.00       -0.07       -0.92        0.00
12/31/1922_24:00             0.00        0.00       -0.07       -0.94        0.00
01/31/1923_24:00             0.00        0.00       -0.08       -0.96        0.00
02/28/1923_24:00             0.00        0.00       -0.08       -0.98        0.00
03/31/1923_24:00             0.00        0.00       -0.08       -1.00        0.00
04/30/1923_24:00             0.00        0.00       -0.09       -1.03        0.00
05/31/1923_24:00             0.00        0.00       -0.09       -1.06        0.00
06/30/1923_24:00             0.00        0.00       -0.09       -1.08        0.00
       .                      .           .           .           .           .
       .                      .           .           .           .           .
       .                      .           .           .           .           .
       .                      .           .           .           .           .
11/30/1929_24:00             0.00        0.00       -0.34       -1.43        0.00
12/31/1929_24:00             0.00        0.00       -0.34       -1.43        0.00
01/31/1930_24:00             0.00        0.00       -0.34       -1.43        0.00
02/28/1930_24:00             0.00        0.00       -0.35       -1.42        0.00
03/31/1930_24:00             0.00        0.00       -0.35       -1.42        0.00
04/30/1930_24:00             0.00        0.00       -0.35       -1.42        0.00
05/31/1930_24:00             0.00        0.00       -0.36       -1.43        0.00
06/30/1930_24:00             0.00        0.00       -0.36       -1.43        0.00
07/31/1930_24:00             0.00        0.00       -0.36       -1.42        0.00
08/31/1930_24:00             0.00        0.00       -0.36       -1.41        0.00
09/30/1930_24:00             0.00        0.00       -0.36       -1.41        0.00
10/31/1930_24:00             0.00        0.00       -0.37       -1.41        0.00
11/30/1930_24:00             0.00        0.00       -0.37       -1.40        0.00
12/31/1930_24:00             0.00        0.00       -0.37       -1.40        0.00
01/31/1931_24:00             0.00        0.00       -0.37       -1.40        0.00
02/28/1931_24:00             0.00        0.00       -0.37       -1.39        0.00
03/31/1931_24:00             0.00        0.00       -0.38       -1.38        0.00
04/30/1931_24:00             0.00        0.00       -0.38       -1.38        0.00
05/31/1931_24:00             0.00        0.00       -0.38       -1.38        0.00
06/30/1931_24:00             0.00        0.00       -0.38       -1.37        0.00
07/31/1931_24:00             0.00        0.00       -0.39       -1.35        0.00
08/31/1931_24:00             0.00        0.00       -0.39       -1.33        0.00
09/30/1931_24:00             0.00        0.00       -0.39       -1.33        0.00
```

Stream Flow Hydrograph Output File Unit 46

The stream hydrograph output file can either contain stream flows or stream surface elevations, depending on the option set by the user in the print control file (Unit 10). The flow or elevation values are printed for the stream nodes specified by the user for each time step of the simulation period.

If the stream flow/elevation values are desired to be printed out to a DSS file, a file name with the extension ".DSS" should be supplied. The following pathname parts are used for output to a DSS file:

Part A:

IWFM

Part B:

R*XXX* where *XXX* is the stream node number

Part C:

One of the following, depending on the output data

i. *FLOW* (when stream flows are printed)

ii. *SURFACE_ELEV* (when stream surface elevations are printed)

Part D:

Start date of the time series depending on the time step used in the Simulation and the value of the BDT variable (starting date and time of simulation period) set in the Simulation main control input file

Part E:

Time step used in the Simulation

Part F:

STREAM_HYDROGRAPHS

```
*                                     ****************************************
*                                     *          STREAM HYDROGRAPH           *
*                                     *            (UNIT=AC-FT)              *
*                                     ****************************************
*                              NODES
*        TIME                    228          275          332          124          153
10/31/1921_24:00           304946.02    350546.28    597406.02      5757.43     12877.64
11/30/1921_24:00           345738.57    389091.31    530458.93      6707.39     13778.94
12/31/1921_24:00           608682.26    810415.04    903141.53     75610.99     23007.87
01/31/1922_24:00           568592.50    683078.72    749267.97     59814.10     33021.35
02/28/1922_24:00           818071.81   1153580.68   1122011.07    201616.97     74583.62
03/31/1922_24:00           830915.48   1028272.34   1027220.18    109116.23     66425.22
04/30/1922_24:00           940506.28   1185547.36   1151798.52     75357.80    117039.22
05/31/1922_24:00           747295.27    990536.10    903184.87    308295.24    350253.26
06/30/1922_24:00           412633.91    495523.86    495940.52    279466.86    313870.93
07/31/1922_24:00           287324.29    285874.20    277980.15      3550.83     90894.57
08/31/1922_24:00           255375.21    240107.33    222350.37      2266.99     44470.03
09/30/1922_24:00           249279.14    253588.10    270682.56      2547.26     28239.69
10/31/1922_24:00           298227.87    351938.58    368477.91     10104.25     23395.60
11/30/1922_24:00           349455.30    461167.57    506909.90     19991.21     27719.00
12/31/1922_24:00           521692.94    854181.49    938721.34     69110.07     55946.84
01/31/1923_24:00           607179.34    801737.07    842126.91     78100.17     89145.80
02/28/1923_24:00           510615.59    624546.23    674274.78     58015.66     54238.00
03/31/1923_24:00           509461.32    606457.21    645604.60     40856.06     55567.70
04/30/1923_24:00           733375.01    937327.50    906823.38     92728.66    139127.13
05/31/1923_24:00           456924.73    524435.85    450460.92    179737.56    247971.44
06/30/1923_24:00           327735.20    339450.47    327415.40     80202.41    132039.56
       .                       .            .            .            .            .
       .                       .            .            .            .            .
       .                       .            .            .            .            .
       .                       .            .            .            .            .
01/31/1929_24:00           418145.89    496400.42    517268.05     17211.15     20478.22
02/28/1929_24:00           531991.48    650208.18    622234.46     29461.03     16948.63
03/31/1929_24:00           511119.67    596990.28    614538.06     31535.60     19356.43
04/30/1929_24:00           504686.99    534779.82    507785.03     16131.19     19540.38
05/31/1929_24:00           390831.96    386859.00    377141.05     13324.83     48921.80
06/30/1929_24:00           281609.37    265193.95    272405.50      8997.47     49637.59
07/31/1929_24:00           216225.84    177620.04    163307.11     13685.55     31441.74
08/31/1929_24:00           202338.04    167042.01    146591.55     31757.94     24551.97
09/30/1929_24:00           196702.23    194752.28    197884.59     18918.36     21095.91
10/31/1929_24:00           231975.32    254898.04    270799.42      9057.39     17765.03
11/30/1929_24:00           303309.38    321898.33    341187.19      8017.25     16188.42
12/31/1929_24:00           864794.48   1109471.32   1012597.85      9117.37     17454.44
01/31/1930_24:00           677935.69    906708.31    925434.56     19608.60     31595.86
02/28/1930_24:00           804792.23   1032185.73   1007764.51     24296.66     24069.39
03/31/1930_24:00           908828.02   1202413.68   1082503.98     18659.34     47052.77
04/30/1930_24:00           573936.10    723983.01    745761.02     13613.70     91602.38
05/31/1930_24:00           428139.18    480817.67    467001.66     10606.73     94819.72
06/30/1930_24:00           275732.58    283409.22    264488.72      9196.06     76239.99
07/31/1930_24:00           226913.64    213080.99    183345.44     12081.00     39515.27
08/31/1930_24:00           210588.92    197845.44    163307.46     32466.83     29455.33
09/30/1930_24:00           213490.53    226852.21    226374.42     39244.94     24948.77
10/31/1930_24:00           218089.47    246980.85    278622.78      8905.55     23549.37
11/30/1930_24:00           240644.46    278091.97    309207.34      8280.25     20614.17
12/31/1930_24:00           281084.22    324326.59    348569.54      7824.31     23210.80
01/31/1931_24:00           419868.32    586536.49    611001.66     13901.42     18729.58
02/28/1931_24:00           385472.78    472767.77    506261.69     11924.48     16668.78
03/31/1931_24:00           460377.36    556390.72    552840.89     14759.42     15630.65
04/30/1931_24:00           299646.81    301295.88    266808.53     13014.85     17663.00
05/31/1931_24:00           242677.56    218697.01    183352.78     13025.81     19686.51
06/30/1931_24:00           205752.92    181546.66    143224.98     11803.68     15668.74
07/31/1931_24:00           182869.79    141690.11     99607.85     15572.26     14343.57
08/31/1931_24:00           176834.82    146082.23    113084.94     13412.90      9360.36
09/30/1931_24:00           174015.57    181272.42    182988.54      4643.41      8499.36
```

Groundwater Level Hydrograph Output Unit 47

The groundwater level hydrograph output file includes the groundwater level at aquifer layers and nodes specified by the user in Unit 10. The layer and node numbers for which hydrographs are desired are specified by the user. If hydrographs at locations other than finite element nodes are desired, then IWFM prints out the element number where the x-y coordinate lies in. If groundwater head averaged over all the aquifer layers is desired, then a value of zero appears for the layer number at the heading of this file.

If the groundwater head hydrographs are desired to be printed out to a DSS file, a file name with the extension ".DSS" should be supplied. The following pathname parts are used for output to a DSS file:

Part A:

IWFM

Part B:

One of the following depending on the output data:

iii. *ID*:L*XXX*:GW*YYY* (if hydrographs are printed for nodes; *ID* is the groundwater hydrograph number listed sequentially in the print control file (Unit 10), *XXX* is the aquifer layer number and YYY is the groundwater node number)

iv. *ID*:L*XXX*:E*YYY* (if hydrographs are printed for x-y coordinates; *ID* is the groundwater hydrograph number listed sequentially in the print control file (Unit 10), *XXX* is the aquifer layer number and *YYY* is the element number that the x-y coordinate falls into)

Part C:

HEAD

Part D:

Start date of the time series depending on the time step used in the Simulation and the value of the BDT variable (starting date and time of simulation period) set in the Simulation main control input file

Part E:

Time step used in the Simulation

Part F:

GROUNDWATER_HYDROGRAPHS

```
*                                        ***************************************
*                                        *       GROUNDWATER HYDROGRAPH        *
*                                        *             (UNIT=FEET)             *
*                                        ***************************************
*                    LAYER      2           3           2           3           1           2
*                  ELEMENT     25          32          32          33          34          34
*        TIME
10/31/1921_24:00        497.0263    505.3219    543.3004    458.4522    433.4353    426.1700
11/30/1921_24:00        505.4606    518.8989    553.6088    461.8528    435.0066    430.3854
12/31/1921_24:00        509.2216    529.4095    557.8937    465.3780    436.2870    433.3676
01/31/1922_24:00        511.5957    537.4561    560.5013    468.7883    437.4383    435.5250
02/28/1922_24:00        513.4828    543.6903    562.5208    472.0072    438.5526    437.1873
03/31/1922_24:00        514.9638    548.5705    564.0660    474.9888    439.3772    438.4208
04/30/1922_24:00        515.8659    552.3538    564.9686    477.6812    440.0135    439.0901
05/31/1922_24:00        517.0825    555.4614    566.2022    480.1556    440.5773    439.9143
06/30/1922_24:00        517.8474    557.9856    567.0513    482.3972    441.0188    440.3641
07/31/1922_24:00        518.4698    560.0529    567.7386    484.4168    441.3708    440.6519
08/31/1922_24:00        519.1669    561.7623    568.3212    486.2388    441.6625    441.0097
09/30/1922_24:00        519.6537    563.1991    568.8564    487.8790    441.8453    441.1804
10/31/1922_24:00        520.1886    564.4162    569.3240    489.3588    441.9427    441.4149
11/30/1922_24:00        520.5497    565.4545    569.7294    490.6892    441.9696    441.5120
      .                    .           .           .           .           .           .
      .                    .           .           .           .           .           .
      .                    .           .           .           .           .           .
      .                    .           .           .           .           .           .
07/31/1930_24:00        514.7297    579.0901    580.3612    501.9473    433.1179    433.2660
08/31/1930_24:00        514.7058    579.1217    580.3654    501.9315    433.0757    433.2736
09/30/1930_24:00        514.6704    579.1412    580.3522    501.9127    433.0182    433.2902
10/31/1930_24:00        514.5757    579.1478    580.3219    501.8881    432.9141    433.2615
11/30/1930_24:00        514.4040    579.1410    580.2744    501.8546    432.7376    433.1635
12/31/1930_24:00        514.2122    579.1211    580.2141    501.8116    432.5679    433.0437
01/31/1931_24:00        514.0661    579.1037    580.2138    501.7699    432.5046    432.9541
02/28/1931_24:00        513.9512    579.0973    580.2521    501.7339    432.4586    432.8846
03/31/1931_24:00        513.7310    579.0599    580.1336    501.6841    432.3532    432.7205
04/30/1931_24:00        513.7003    579.0528    580.2108    501.6436    432.3270    432.7175
05/31/1931_24:00        513.6266    579.0446    580.2038    501.6034    432.2980    432.6976
06/30/1931_24:00        513.5331    579.0289    580.1695    501.5606    432.2466    432.6630
07/31/1931_24:00        513.2710    578.9995    580.0986    501.5057    432.1625    432.4580
08/31/1931_24:00        513.1958    578.9633    580.0439    501.4486    432.0850    432.4166
09/30/1931_24:00        513.1211    578.9190    579.9776    501.3896    432.0067    432.3979
```

Groundwater Level Output at Every Node Unit 48

This output file displays the groundwater levels at each groundwater node in every layer modeled. If the aquifer dries at a ground water node, i.e. the groundwater head is equal to the elevation of the bottom of the aquifer at that node, then the elevation of the aquifer bottom is added 20000 and this value is printed out for that node. If a node is inactive, i.e. aquifer thickness becomes zero at that node, then the head at the above active node is added 40000 and this value is printed out for that node.

If the groundwater head values at all nodes are desired to be printed out to a DSS file, a file name with the extension ".DSS" should be supplied. The following pathname parts are used for output to a DSS file:

Part A:

IWFM

Part B:

L*XXX*:GW*YYY* where *XXX* is the aquifer layer number and *YYY* is the groundwater node number

Part C:

HEAD

Part D:

Start date of the time series depending on the time step used in the Simulation and the value of the BDT variable (starting date and time of simulation period) set in the Simulation main control input file

Part E:

Time step used in the Simulation

Part F:

GW_HEAD_AT_ALL_NODES

```
*                                   ****************************************
*                                   *    GROUNDWATER HEAD AT ALL NODES     *
*                                   *            (UNIT=FEET)               *
*                                   ****************************************
*                         NODE
*        TIME                1           2           3           4 .....        1392        1393
10/31/1921_24:00      603.8759    607.5278    625.7092    581.1468 .....   1303.5031   1406.4968
                      587.3636    589.6517    609.4789    568.8487 .....    551.9865    541.2226
                      524.0269    536.3722    539.5226    520.9363 .....    512.7689    500.6641

11/30/1921_24:00      602.3052    607.6252    626.7251    583.3910 .....   1294.1678   1399.5461
                      574.1580    590.7881    611.6388    571.4923 .....    584.5448    577.6066
                      539.0812    554.0353    564.0575    538.2114 .....    512.9973    501.1272

12/31/1921_24:00      600.6682    607.3225    627.1661    584.8115 .....   1284.4702   1392.1206
                      572.5843    591.9127    614.0963    574.2521 .....    611.9763    609.1765
                      547.9035    565.6898    580.5905    550.1930 .....    513.3568    501.7591

01/31/1922_24:00      599.0127    606.9224    627.3983    585.8409 .....   1274.6344   1384.4100
                      571.7971    592.5587    615.8182    576.3203 .....    635.4563    636.7428
                      553.1150    573.3486    591.7580    558.5589 .....    513.8258    502.5345

02/28/1922_24:00      598.0007    606.5556    627.5793    586.6836 .....   1264.7956   1376.5410
                      571.4039    592.9258    617.0151    577.8796 .....    655.8388    660.9555
                      556.2206    578.3657    599.3163    564.4426 .....    514.3876    503.4325

03/31/1922_24:00      597.0432    606.0911    627.6306    587.3178 .....   1255.0360   1368.5925
                      570.9003    592.9970    617.7758    579.0182 .....    673.7538    682.3411
                      557.9847    581.5971    604.4169    568.5969 .....    515.0290    504.4355

04/30/1922_24:00      596.1069    605.4711    627.5004    587.6851 .....   1245.4098   1360.6211
                      569.9882    592.6191    617.9707    579.4381 .....    689.6646    701.3244
                      558.7786    583.5345    607.7490    571.3987 .....    515.7395    505.5288
        .                 .           .           .           .    .....       .           .
        .                 .           .           .           .    .....       .           .
        .                 .           .           .           .    .....       .           .
        .                 .           .           .           .    .....       .           .
03/31/1923_24:00      578.0787    595.6276    622.0552    586.3809 .....   1153.5250   1277.9583
                      555.8630    584.1644    613.8140    578.9021 .....    790.2306    816.2195
                      549.0497    580.4291    610.7209    576.5111 .....    526.3051    520.8205

04/30/1923_24:00      577.2108    594.6909    621.4323    586.0505 .....   1146.5714   1271.1487
                      555.7621    583.5216    613.4354    578.9625 .....    795.9619    822.1808
                      548.3036    579.6329    610.1929    576.2712 .....    527.4204    522.3596

05/31/1923_24:00      575.8130    593.7533    620.7987    585.7040 .....   1139.8494   1264.4745
                      555.4580    582.6953    612.8598    578.6788 .....    801.1448    827.5237
                      547.7248    578.8390    609.6516    576.0152 .....    528.5522    523.9093

06/30/1923_24:00      574.4749    592.8085    620.1464    585.3284 .....   1133.3543   1257.9365
                      555.1210    581.8381    612.2211    578.2846 .....    805.7389    832.2964
                      547.2408    578.0372    609.0800    575.7105 .....    529.6977    525.4665

07/31/1923_24:00      573.0619    591.8635    619.4856    584.9411 .....   1127.0784   1251.5323
                      554.5952    580.9833    611.6030    577.9300 .....    809.8029    836.5370
                      546.7502    577.2295    608.4959    575.3880 .....    530.8541    527.0284

08/31/1923_24:00      571.8148    590.9178    618.8145    584.5388 .....   1121.0136   1245.2584
                      554.0270    580.1375    610.9685    577.5478 .....    813.3713    840.2619
                      546.2428    576.4217    607.8981    575.0442 .....    532.0192    528.5923

09/30/1923_24:00      570.7008    589.9711    618.1329    584.1204 .....   1115.1568   1239.1155
                      553.3986    579.2833    610.3159    577.1388 .....    816.9789    843.8726
                      545.7051    575.6108    607.2851    574.6773 .....    533.1935    530.1578
```

Layer Vertical Flow Output File Unit 49

This output file lists the vertical flow between aquifer layers at each subregion for multi-layered aquifer systems. The values listed in this file are vertical flows between an aquifer layer and the upper adjacent layer at every time step of the simulation period. A negative value represents downward flow direction, whereas a positive value represents upward flow direction.

If the subregional vertical flows are desired to be printed out to a DSS file, a file name with the extension ".DSS" should be supplied. The following pathname parts are used for output to a DSS file:

Part A:

IWFM

Part B:

SR*XXX*:L*YYY*-L*ZZZ* where *XXX* is the subregion number, *YYY* is the aquifer layer number and *ZZZ* is the aquifer layer number below layer *YYY*

Part C:

FLOW

Part D:

Start date of the time series depending on the time step used in the Simulation and the value of the BDT variable (starting date and time of simulation period) set in the Simulation main control input file

Part E:

Time step used in the Simulation

Part F:

VERTICAL_FLOW

```
*                                         ***************************************
*                                         *           VERTICAL FLOW             *
*                                         *          (UNIT=ACRE-FEE)            *
*                                         *   [POSITIVE IN UPWARD DIRECTION]    *
*                                         ***************************************
```

* REGION	1		2		3	
* LAYER	L1-L2	L2-L3	L1-L2	L2-L3	L1-L2	L2-L3
* TIME						
10/31/1921_24:00	-49611.25	-26545.81	-70299.78	-27968.47	6415.07	-12948.10
11/30/1921_24:00	-35199.56	-22570.65	-42002.04	-25412.38	-2655.11	-8903.49
12/31/1921_24:00	-27561.39	-17531.45	-30188.69	-22912.35	-7136.24	-7322.48
01/31/1922_24:00	-23149.77	-14552.24	-24113.13	-20841.37	-8504.42	-6404.39
02/28/1922_24:00	-20293.05	-12440.25	-21115.48	-19180.71	-9480.44	-5807.09
03/31/1922_24:00	-18127.96	-10894.92	-18722.80	-17791.58	-9077.82	-5333.00
04/30/1922_24:00	-17066.00	-9648.41	-20588.96	-16318.18	-19695.60	-4199.87
05/31/1922_24:00	-14979.36	-9022.10	-19950.91	-15282.95	-15360.50	-4161.90
06/30/1922_24:00	-12529.45	-8176.90	-19972.24	-14280.78	-11101.21	-4087.27
07/31/1922_24:00	-11741.99	-7725.82	-20292.02	-13360.37	-9418.21	-3910.27
08/31/1922_24:00	-9112.85	-7301.80	-19461.42	-12607.80	-8664.68	-3737.56
09/30/1922_24:00	-8607.45	-6892.54	-17844.19	-11988.42	-8110.35	-3575.72
10/31/1922_24:00	-7834.85	-6582.88	-13928.76	-11580.70	-7213.94	-3420.80
11/30/1922_24:00	-7364.13	-6280.89	-11771.88	-11135.02	-6849.40	-3276.61
12/31/1922_24:00	-7011.36	-6023.94	-10704.04	-10703.95	-7132.52	-3173.19
01/31/1923_24:00	-6755.30	-5810.41	-9982.81	-10298.80	-7212.04	-3101.16
02/28/1923_24:00	-6450.23	-5613.76	-9230.00	-9909.71	-6467.46	-2995.67
03/31/1923_24:00	-6942.59	-5301.88	-10012.55	-9401.25	-6606.87	-2819.46
04/30/1923_24:00	-6163.79	-5253.35	-10932.62	-9001.99	-16771.53	-2163.60
05/31/1923_24:00	-6020.86	-5091.87	-12376.02	-8551.54	-12927.73	-2262.07
06/30/1923_24:00	-5330.12	-5006.71	-12488.83	-8193.43	-8953.24	-2396.17
.	.	.	.	.	.	.
.	.	.	.	.	.	.
.	.	.	.	.	.	.
.	.	.	.	.	.	.
06/30/1929_24:00	-41.18	-128.58	-6158.20	-1739.28	-6160.02	-1366.90
07/31/1929_24:00	171.88	-146.61	-7556.22	-1590.48	-6385.72	-1361.71
08/31/1929_24:00	282.00	-146.08	-7766.35	-1522.39	-6531.56	-1367.42
09/30/1929_24:00	419.24	-145.61	-6993.08	-1515.24	-6273.37	-1366.07
10/31/1929_24:00	498.04	-130.04	-5463.52	-1553.78	-5906.08	-1353.75
11/30/1929_24:00	560.29	-99.14	-3604.03	-1618.91	-5622.06	-1344.98
12/31/1929_24:00	466.72	-97.13	-2377.00	-1678.06	-5941.73	-1370.27
01/31/1930_24:00	406.55	-102.69	-2315.91	-1726.65	-5929.78	-1395.37
02/28/1930_24:00	288.21	-125.66	-2288.80	-1770.91	-5872.92	-1419.78
03/31/1930_24:00	209.65	-146.47	-1913.73	-1794.41	-5487.56	-1415.10
04/30/1930_24:00	-180.51	-90.58	-2699.81	-1686.30	-7664.89	-1191.29
05/31/1930_24:00	125.59	-148.92	-3807.46	-1618.14	-6646.55	-1315.00
06/30/1930_24:00	213.71	-153.15	-5416.16	-1474.06	-6312.25	-1334.39
07/31/1930_24:00	18.46	-106.56	-6749.40	-1341.40	-6362.15	-1331.23
08/31/1930_24:00	174.56	-114.61	-6932.39	-1284.49	-6448.21	-1336.58
09/30/1930_24:00	294.48	-113.68	-6028.20	-1293.81	-6197.88	-1340.42
10/31/1930_24:00	374.34	-97.15	-4412.63	-1346.91	-5902.11	-1317.90
11/30/1930_24:00	443.06	-65.00	-2487.50	-1424.36	-5517.79	-1307.23
12/31/1930_24:00	492.57	-37.73	-1506.47	-1447.37	-5267.86	-1285.32
01/31/1931_24:00	475.96	-24.45	-1260.46	-1459.67	-5571.25	-1287.47
02/28/1931_24:00	460.79	-18.34	-1121.43	-1463.01	-5209.33	-1269.62
03/31/1931_24:00	264.09	12.33	-1504.41	-1415.69	-5297.28	-1233.29
04/30/1931_24:00	393.57	-19.09	-4090.52	-1217.64	-5631.67	-1210.72
05/31/1931_24:00	415.78	-24.88	-4781.27	-1143.81	-6333.39	-1234.72
06/30/1931_24:00	436.10	-21.71	-5257.21	-1069.47	-6498.52	-1244.72
07/31/1931_24:00	207.00	23.21	-6679.01	-933.00	-6812.59	-1254.06
08/31/1931_24:00	353.55	10.27	-6890.77	-877.25	-6878.80	-1271.76
09/30/1931_24:00	470.97	4.74	-5970.82	-895.43	-6522.20	-1275.98

### Groundwater Heads for TECPLOT		Unit 50

This file lists the model grid and groundwater heads at each node to be used by TECPLOT, a commercially available software. TECPLOT can be used for analysis of the simulation results including the animation of the groundwater elevations.

### Subsidence Values for TECPLOT		Unit 51

This file lists the model grid and subsidence values at each node to be used by TECPLOT, a commercially available software. TECPLOT can be used for analysis of the simulation results including the animation of the subsidence.

### Final Simulation Results		Unit 52

This file lists the simulation results at the end of the simulation period. It is in a format that can readily be used as initial conditions data file (Unit 11) for following simulation periods. For instance, consider an initial IWFM run performed for a simulation period that starts at January 1, 1973 and ends at December 31, 1992. Final simulation results output file will include all simulation results at the end of December 31, 1992. To perform a second IWFM run for a simulation period that starts at January 1, 1993 file Unit 51 can be used as an initial conditions data file. Similar to the groundwater head output at every node (Unit 48), 20000 is used as a flag at dry nodes and 40000 is used as a flag for inactive nodes in reporting the final groundwater heads. The interbed thickness and pre-consolidation head values at inactive nodes are printed as 9999.000.

```
C***************************************************************************
C ***** SIMULATION RESULTS AT TIME     30.00 day
C***************************************************************************
C
C ***** GROUNDWATER HEAD VALUES
C***************************************************************************
C   LAYER   1
C***************************************************************************
   1.000000
  20605.0000000000        20605.0000000000        621.900070329929   .....   432.813026771975        496.650645102
  387.571617077423        535.472525889578        770.051718188966   .....   715.004537846308        20720.0000000
  20520.0000000000        395.571091712471        375.646444448531   .....   366.185587858368        20465.0000000
  .                       .                       .                  .....   .                       .
  .                       .                       .                  .....   .                       .
  .                       .                       .                  .....   .                       .
  21300.0000000000        555.566649143294        450.171865581857   .....   421.932037799460        486.146185556
  20874.0000000000        1712.64559618794        668.013419073559   .....   845.969382110627        1421.91085976
  1027.94758321902        1330.14175314542        1434.54721746164
C***************************************************************************
C   LAYER   2
C***************************************************************************
   1.000000
  20555.0000000000        594.268212596875        621.825955555383   .....  433.552481435639        495.7807189708
  387.778092011510        491.217612864044        722.992952744224   .....  667.187888489437        670.9031509164
  458.879924305839        396.186699354260        376.254030997574   .....  366.524325678366        401.6651417534
  .                       .                       .                  .....  .                       .
  .                       .                       .                  .....  .                       .
  .                       .                       .                  .....  .                       .
  1127.85314443836        537.429105064827        455.516111277596   .....  426.995184810763        487.1666262329
  20724.0000000000        41712.6455961879        644.725948978744   .....  40845.9693821106        41421.91085976
  41027.9475832190        41330.1417531454        41434.5472174616
C***************************************************************************
C   LAYER   3
C***************************************************************************
   1.000000
  40555.0000000000        40594.2682125969        40621.8259555554   .....  440.557604278229        487.7849858411
  40387.7780920115        40491.2176128640        40722.9929527442   .....  40667.1878884894        536.1895471903
  452.576852795560        403.915656756026        381.457930854301   .....  370.616199540561        40401.66514175
  .                       .                       .                  .....  .                       .
  .                       .                       .                  .....  .                       .
  .                       .                       .                  .....  .                       .
  41127.8531444384        492.965764857591        446.602927522595   .....  483.122301861706        515.4349897570
  445.701134285053        41712.6455961879        532.372134681844   .....  40845.9693821106        41421.91085976
  41027.9475832190        41330.1417531454        41434.5472174616
C ***** ROOT ZONE SOIL MOISTURE AS VOLUME
   1.000000
     1   0.00000000000000      576993.054209681      51816807.0818276  .....     0.00000000000000      0.00000000000
     2   0.00000000000000      82028734.2920410      200045703.883344  .....     0.00000000000000      0.00000000000
     3   0.00000000000000      0.00000000000000      11299314.5423792  .....     0.00000000000000      0.00000000000
     .   .                     .                     .                 .....     .                     .
     .   .                     .                     .                 .....     .                     .
     .   .                     .                     .                 .....     .                     .
    20   0.00000000000000      241001824.706734      45783364.4073317  .....     0.00000000000000      0.00000000000
    21   0.00000000000000      484531638.526806      100058074.937437  .....     0.00000000000000      0.00000000000
C ***** UNSATURATED ZONE SOIL MOISTURE AS A FRACTION OF TOTAL POROSITY
   1.000000
     1   4.438889455363878E-003   2.556338171906956E-010
     2   0.00000000000000         0.00000000000000
     3   0.00000000000000         0.00000000000000
     .   .                        .
     .   .                        .
     .   .                        .
  1390   0.00000000000000         0.00000000000000
  1391   0.00000000000000         0.00000000000000
  1392   0.00000000000000         0.00000000000000
C ***** SMALL WATERSHED SOIL MOISTURE AND GROUNDWATER STORAGE
   1.000000
     1  0.260192828355463         9.41707953957551
     2  1.412475353929657E-002    9.41707953957551
     3  5.451659260781131E-003    9.41707953957551
     .  .                         .
     .  .                         .
     .  .                         .
    14  0.128745815483066         9.41707953957551
    15  1.300964141777316E-002    9.41707953957551
C ***** LAKE ELEVATIONS
   1.000000
  1    281.962865162222
  2    184.611099679168
C ***** INTERBED THICKNESS
C***************************************************************************
C   LAYER   1
C***************************************************************************
```

```
   1.000000
  12.9999393802902      11.9999382525607      11.9999503238972   .....   14.0001551715175      10.9998228233117
  21.9999595701265      25.9999757255399      22.9999401479066   .....    7.99997640339434      7.99997528206760
  7.99997291208803      8.00007203961515      13.0000658971613   .....    8.00002900121345      10.9999627496099
  .                     .                     .                  .....    .                     .
  .                     .                     .                  .....    .                     .
  .                     .                     .                  .....    .                     .
  6.99978170442880      0.00000000000000      6.00000464037244   .....   18.0000754952138      33.9999137364433
  16.9992171481959      32.9995389991466      100.239832534616   .....   81.0067651678598      65.0218038106907
  65.0062327569299      63.0051292138376      63.0061939804593
C***********************************************************************
C   LAYER   2
C***********************************************************************
   1.000000
  3.99999134628982      4.00000554782836      4.00002368708255   .....   4.00001084456937      2.99996153491550
  4.99989038233091      5.00005012153220      5.00002076647771   .....   5.00000692749269      4.99998409591728
  8.99987728273730      9.00003145623023      9.99997993124233   .....   9.99994079452986      10.0000074313797
  .                     .                     .                  .....   .                     .
  .                     .                     .                  .....   .                     .
  .                     .                     .                  .....   .                     .
  10.0012534674304      7.00177363467500      10.0005020371667   .....  14.9996750020413      10.0018201664987
  34.9992226881236      0.00000000000000      135.086761953138   .....   0.00000000000000      0.00000000000000
  0.00000000000000      0.00000000000000      0.00000000000000
C***********************************************************************
C   LAYER   3
C***********************************************************************
   1.000000
  0.00000000000000      0.00000000000000      0.00000000000000   .....   0.00000000000000      0.00000000000000
  0.00000000000000      0.00000000000000      0.00000000000000   .....   0.00000000000000      0.00000000000000
  0.00000000000000      0.00000000000000      0.00000000000000   .....   0.00000000000000      0.00000000000000
  .                     .                     .                  .....   .                     .
  .                     .                     .                  .....   .                     .
  .                     .                     .                  .....   .                     .
  0.00000000000000      0.00000000000000      0.00000000000000   .....   0.00000000000000      0.00000000000000
  0.00000000000000      0.00000000000000      0.00000000000000   .....   0.00000000000000      0.00000000000000
  0.00000000000000      0.00000000000000      0.00000000000000
C ***** PRECONSOLIDATION HEAD VALUES
C***********************************************************************
C   LAYER   1
C***********************************************************************
   1.000000
  506.000000000000        506.000000000000        523.000000000000   .....   330.000000000000        400.00000000
  288.000000000000        436.000000000000        671.000000000000   .....   616.000000000000        621.00000000
  421.000000000000        294.000000000000        275.000000000000   .....   265.000000000000        366.00000000
  .                       .                       .                  .....   .                       .
  .                       .                       .                  .....   .                       .
  .                       .                       .                  .....   .                       .
  750.000000000000        555.566649143294        450.000000000000   .....   280.000000000000        340.00000000
  750.000000000000        750.000000000000        668.013419073559   .....   750.000000000000        750.00000000
  750.000000000000        750.000000000000        750.000000000000
C***********************************************************************
C   LAYER   2
C***********************************************************************
   1.000000
  455.000000000000        494.000000000000        521.000000000000   .....   333.000000000000        399.00000000
  293.000000000000        389.000000000000        622.000000000000   .....   567.000000000000        572.00000000
  362.000000000000        295.000000000000        277.000000000000   .....   268.000000000000        302.00000000
  .                       .                       .                  .....   .                       .
  .                       .                       .                  .....   .                       .
  .                       .                       .                  .....   .                       .
  750.000000000000        431.000000000000        404.000000000000   .....   280.000000000000        340.00000000
  407.000000000000        9999.00000000000        452.000000000000   .....   9999.00000000000        9999.0000000
  9999.00000000000        9999.00000000000        9999.00000000000
C***********************************************************************
C   LAYER   3
C***********************************************************************
   1.000000
  9999.00000000000        9999.00000000000        9999.00000000000   .....   339.000000000000        395.00000000
  9999.00000000000        9999.00000000000        9999.00000000000   .....   9999.00000000000        441.00000000
  359.000000000000        300.000000000000        282.000000000000   .....   274.000000000000        9999.0000000
  .                       .                       .                  .....   .                       .
  .                       .                       .                  .....   .                       .
  .                       .                       .                  .....   .                       .
  9999.00000000000        480.459285073626        442.320792394920   .....   280.000000000000        340.00000000
  445.000000000000        9999.00000000000        497.860000000000   .....   9999.00000000000        9999.0000000
  9999.00000000000        9999.00000000000        9999.00000000000
```

Binary Output Files

The binary files contain the simulation results and they are used in the post-processing portion (Budget and Z-Budget) of IWFM in order to generate detailed water budget tables for modeled hydrologic processes. The files are generated in the simulation program, and must be copied to the folder with the IWFM Budget and Z-Budget executable programs. The binary files that can be generated are

- Binary output for groundwater zone budget (Unit 31)
- Binary output for small watershed flow components (Unit 32)
- Binary output for element sub-group details (Unit 33)
- Binary output for diversion details (Unit 34)
- Binary output for stream budget by reach (Unit 35)
- Binary output for lake budget (Unit 36)
- Binary output for land and water use budget (Unit 37)
- Binary output for stream budget (Unit 38)
- Binary output for root zone moisture budget (Unit 39)
- Binary output for groundwater budget (Unit 40)

5. Budget

The budget program tabulates the simulation output, allowing the user to generate the following tables based on output files created in the Simulation part of IWFM: land and water use, stream flows, root zone moisture accounting, groundwater, element sub-group accounting, small watersheds, lakes, stream reaches and diversion details. This chapter describes the input and output files, as well as providing input and output file samples.

5.1. Input Files

The main input file and at least one of the binary output files generated during IWFM simulation is required to run the budget program. The binary files contain results produced from the simulation of IWFM. A list of the simulation output unit numbers, corresponding budget input unit numbers and file descriptions are given in Table 5.1. The simulation output unit numbers are specified in the main simulation input file (Unit 5) and the budget input unit numbers are listed in the main budget input file. The file names are variable, depending on user specification. However, the file names for binary output from the simulation program must be the same as the binary input file names specified in the main budget input file.

Simulation output	Budget input	Description
Unit 37	Unit 1	Land and water use simulation output
Unit 38	Unit 2	Simulated stream flow output
Unit 39	Unit 3	Root zone moisture accounting output
Unit 40	Unit 4	Simulated groundwater output
Unit 33	Unit 5	Element sub-group accounting output
Unit 32	Unit 6	Small watershed boundary condition output
Unit 36	Unit 7	Lake simulation output
Unit 35	Unit 8	Stream reach output
Unit 34	Unit 9	Diversion detail output

Table 5.1 Unit numbers for binary simulation output and budget input

Main Input File

The main input file contains names of the binary files generated in the simulation part of IWFM, output unit controls, beginning and ending time step as well as the frequency that the budget information is reported. The values stored in the binary files have units used in the simulation. Depending on the time-tracking option used in Simulation, the user is required to enter beginning time (TBEGIN for non-time tracking simulation, BDT for time tracking simulation), ending time (TLAST for non-time tracking simulation, EDT for time tracking simulation) and the print-out frequency (MPRNT) for the budget outputs. If the time series data for each budget table is required to be printed out to a DSS file instead of an ASCII text file, a file name with ".DSS" extension should be supplied.

The user must specify the number of subregions modeled in IWFM simulation, the name of each subregion modeled and the printing option for each subregion. To print the budget information for a subregion, the print switch value (IPRINT) is set to any value other than zero. If budget information for a subregion is not to be printed, the print switch must be set to zero. The budget information for the entire model domain is printed always. The following is a list of variables that need to be defined in this input file:

FACTLTOU	Factor to convert simulation unit of length to output unit of length
UNITLTOU	Output unit of length (maximum of 8 characters)
FACTAROU	Factor to convert simulation unit of area to output unit of area
UNITAROU	Output unit of area (maximum of 8 characters)
FACTVLOU	Factor to convert simulation unit of volume to output unit of volume
UNITVLOU	Output unit of volume (maximum of 8 characters)
TBEGIN	Beginning time step for the budget tables; used only for non-time tracking simulations
TLAST	Ending time step for the budget tables; used only for non-time tracking simulations
BDT	Beginning date and time for the budget tables; used only for time tracking simulations
EDT	Ending date and time for the budget tables; used only for time tracking simulations
MPRNT	Frequency of budget output

NREGN	Number of subregions modeled in IWFM simulation
IR	Subregion number
IPRINT	Budget print option (enter zero to depress budget printing for a subregion)
NAME	Subregion name

```
C*******************************************************************************
C
C                   INTEGRATED WATER FLOW MODEL (IWFM)
C                          *** Version ### ***
C
C*******************************************************************************
C
C                            BUDGET INPUT FILE
C                        for IWFM Post-Processing
C
C
C              Project:  IWFM Version ### Release
C                        California Department of Water Resources
C              Filename: BUDGET.IN
C
C*******************************************************************************
C
C                             File Description
C
C     This file contains the the names and descriptions of all binary input files,
C     conversion factors and output control options for running the post-processor.
C
C*******************************************************************************
C                          File Description
C    *Listed below are all input and output file names used when running the
C     IWFM Budget post-processor.
C
C    *If the budget tables are desired to be created in ASCII text files,
C     leave the DSS output file name blank.
C
C    *If a file does not exist for a project, leave the file name blank
C     For example, if stream flow budget is not desired, the file name and
C     description columns for unit 2 will appear as:
C
C     FILE NAME                             UNIT DESCRIPTION
C                                           / 2: BINARY FILE GENERATED BY SIMULATION FOR STREAMFLOW BUDGET
C----------------------------------------------------------------------
C     FILE NAME                             UNIT DESCRIPTION
C----------------------------------------------------------------------
   LANDWATER.BIN                            / 1 : BINARY FILE GENERATED BY SIMULATION FOR LAND AND WATER USE BUDGET
   STREAM.BIN                               / 2 : BINARY FILE GENERATED BY SIMULATION FOR STREAMFLOW BUDGET
   ROOTZN.BIN                               / 3 : BINARY FILE GENERATED BY SIMULATION FOR ROOT ZONE MOISTURE BUDGET
   GROUND.BIN                               / 4 : BINARY FILE GENERATED BY SIMULATION FOR GROUNDWATER BUDGET
   ELEMENTBUD.BIN                           / 5 : BINARY FILE GENERATED BY SIMULATION FOR ELEMENT SUB-GROUP DETAILS
   SMWSHED.BIN                              / 6 : BINARY FILE GENERATED BY SIMULATION FOR SMALL WATERSHED FLOW COMPONENTS
   LAKE.BIN                                 / 7 : BINARY FILE GENERATED BY SIMULATION FOR LAKE BUDGET
   STREAMRCH.BIN                            / 8 : BINARY FILE GENERATED BY SIMULATION FOR STREAM BUDGET BY REACH
   DIVERDTL.BIN                             / 9 : BINARY FILE GENERATED BY SIMULATION FOR DIVERSION DETAILS
   BUDGETS.DSS                              / 10: DSS OUTPUT FILE TO STORE THE WATER BUDGET DATA
C*******************************************************************************
C                    Output Unit Control
C
C     FACTLTOU; Factor to convert simulation unit of length to output unit of length
C     UNITLTOU; Output unit of length (8 characters max.)
C     FACTAROU; Factor to convert simulation unit of area to output unit of area
C     UNITAROU; Output unit of area (8 characters max.)
C     FACTVLOU; Factor to convert simulation unit of volume to output unit of volume
C     UNITVLOU; Output unit of volume (8 characters max.)
C
C-----------------------------------------------------------------------------
C    VALUE                          DESCRIPTION
C-----------------------------------------------------------------------------
    1.0                             / FACTLTOU
    FEET                            / UNITLTOU
    0.000000022957                  / FACTAROU
    TAC                             / UNITAROU
    0.000000022957                  / FACTVLOU
    TAF                             / UNITVLOU
C*******************************************************************************
C                    Output Cache Size
C
C     CACHE;   Cache size in terms of number of values stored for time series
C              data output
C
C-----------------------------------------------------------------------------------
C    VALUE                          DESCRIPTION
C-------------------------------------------------------------------------------
    1000                            / CACHE
C*******************************************************************************
C                        Budget Output Control Options
C                    (Simulation Date and Time NOT Tracked)
C
C     If the actual simulation date and time is NOT tracked enter the following
C     variables. Otherwise, comment out the following variables and use the
C     "Simulation Date and Time NOT Tracked" option below.
C
C     TBEGIN ; Beginning time for the budget tables
C               * Use ##.# format
C     TLAST  ; Ending time for the budget tables
C               * Use ##.# format
```

```
C    MPRNT  ; Frequency of budget output
C
C-----------------------------------------------------------------------------
C   VALUE                       DESCRIPTION
C-----------------------------------------------------------------------------
*                               / TBEGIN
*                               / TLAST
*                               / MPRNT
C-----------------------------------------------------------------------------
C                       Budget Output Control Options
C                    (Simulation Date and Time Tracked)
C
C    If the actual simulation date and time is tracked enter the following
C    variables. Otherwise, comment out the following variables and use the
C    "Simulation Date and Time NOT Tracked" option above.
C
C    BDT    ; Begining date and time for the budget output
C              * Use MM/DD/YYYY_HH:MM format
C              * Midnight is 24:00
C    EDT    ; Ending date and time for the budget output
C              * Use MM/DD/YYYY_HH:MM format
C              * Midnight is 24:00
C    MPRNT  ; Frequency of budget output
C
C-----------------------------------------------------------------------------
C   VALUE                       DESCRIPTION
C-----------------------------------------------------------------------------
    09/30/1920_24:00            / BDT
    09/30/2003_24:00            / EDT
    1                           / MPRNT
C*****************************************************************************
C                          Subregion Names and Print Options
C
C   The following lists the subregion names and the option to generate a budget
C   table for a subregion.
C
C   NREGN ; Number of subregions modeled
C   IR    ; Subregion number
C   IPRINT; Budget print option (enter 0 to depress budget print-out for a subregion)
C   NAME  ; Name of subregion (maximum 20 characters long)
C
C-----------------------------------------------------------------------------
C   VALUE                       DESCRIPTION
C-----------------------------------------------------------------------------
     3                          / NREGN
C-----------------------------------------------------------------------------
C  IR    IPRINT           NAME
C-----------------------------------------------------------------------------
   1       1              REGION1
   2       1              REGION2
   3       1              REGION3
```

Binary Input Files

The budget program binary input files are created during IWFM simulation. The binary files generated for post-processing are specified by the user in the IWFM simulation main input file (Unit 5). As few as one and as many as nine binary files can be input for processing IWFM output in tabular form or in DSS file format. All binary files must be specified in the main budget input file. Refer to Table 5.1 for a list of unit numbers that correspond with the binary input files.

5.2. Output Files

The budget program generates up to nine output files. More specifically, a single ASCII output file is generated for each binary input file provided by the user, if a DSS file name is not specified. The ASCII output file names are the same with the names of binary files except that their extension names are replaced with "BUD". For instance, if the lake budget binary file is named as LAKE.BIN, the ASCII output file name after running budget program will be LAKE.BUD. The output files include information generated by IWFM simulation. All ASCII output files organized by subregion include a table for each subregion specified for printing in the main input file, as well as the total modeled area. The other output files are organized by element sub-group, small watershed, lake or stream reach. The beginning time, ending time and frequency of each output file is based on the values of TBEGIN (or BDT), TLAST (or EDT) and MPRNT specified in the main budget input file. Therefore, each budget table ranges from time

TBEGIN (or BDT) to TLAST (or EDT) and the values are accumulated and written for every time interval (MPRNT) within the output time range.

If a file name with extension ".DSS" is specified for budget data print-out then all time series data for all of the required budget tables are printed to that file. The pathnames to locate budget table components in the DSS file will be explained later for each budget table.

Land and Water Use Budget Unit 1

The land and water use budget is organized by subregion. A budget table is produced for each subregion specified for printing in the main input file, as well as the total modeled area. The title printed for each subregional land and water use budget includes IWFM version number, subregion name given by the user, the unit of data columns and the area of the subregion. For example, all land and water use budget columns are in volumetric units except *Time*, *Agricultural Area* and *Urban Area*. The output units and conversion factors for area (UNITAROU and FACTAROU) and volume (UNITVLOU and FACTVLOU) are specified by the user in the main budget input file.

The total agricultural and urban areas, as well as the potential consumptive use of applied water are reported in the output, followed by the components that the land and water use budget is comprised of. A positive or negative sign is given for each column that is a component of the subregional mass balance. The *Shortage* column is the resulting balance, based on water use components. A value of zero in this column indicates that the available water supply (surface water diversions and groundwater pumping) meets the agricultural or urban supply requirements. A positive value indicates that the supply is not a large enough quantity to satisfy water requirements. Conversely, a negative value in the *Shortage* column signifies a water supply surplus. The amount of return flow that is re-used in agricultural and urban areas is also listed. In the last two columns, total water imports to and exports from the subregion are listed. The following table defines each column in the land and water use budget table printed out to ASCII file and lists the variable(s) associated with each column as represented in the IWFM code:

LAND AND WATER USE BUDGET

COL. #	COLUMN NAME	VARIABLE	DESCRIPTION
1	Time	IFLAG	Time step
Agricultural Area			
2	Area	RLAND(IRL+1)	Agricultural area
3	Potential CUAW	RCUAW	Applied water needed for optimum agricultural conditions where adequate crop production is guaranteed by maintaining ET rates at their potential levels, soil moisture losses to deep percolation are minimized, and the minimum soil moisture requirements are met at all times
4	Agricultural Supply Requirement	RDMAG	Amount of water necessary to meet the agricultural demand that is either computed internally or specified by the user in the Unit 19 simulation input file
5	Pumping (-)	RPUMP_AG	Portion of groundwater pumping that is used to meet the agricultural supply requirement
6	Diversion (-)	RDELI_AG	Portion of the actual amount of water diverted from streams that is used to meet the agricultural supply requirement
7	Shortage (=)	RDMSH_AG	Resulting water balance with respect to the agricultural supply requirements and supply specified in preceding columns
8	Re-use	RUW_AG	Amount of return flow that is re-used in agricultural areas
Urban Area			
9	Area	RLAND(IRL+2)	Urban area

10	Urban Supply Requirement	RDMUR	User specified indoor and outdoor urban demand
11	Pumping (-)	RPUMP_URB	Portion of groundwater pumping that is used to meet the urban supply requirement
12	Diversion (-)	RDELI_URB	Portion of the actual amount of water diverted from streams that is used to meet the urban supply requirement
13	Shortage (=)	RDMSH_URB	Resulting water balance with respect to the urban supply requirements and supply specified in preceding columns
14	Re-use	RUW_URB	Amount of return flow that is re-used in urban areas
Region Imports/Exports			
15	Import	RDVIM+RPUMPIM	Amount of water imported into a subregion from either another subregion, or from outside the modeled area
16	Export	RDVEX+RPUMPEX	Amount of water exported from subregion to either another subregion, or outside the modeled area

If a DSS file is used for print-out, the following pathnames are used:

Part A:

IWFM_L&W_USE_BUD

Part B:

SR*XXX (TTT)* where *XXX* is the subregion number and *TTT* is the name of the subregion

Part C:

One of the following, depending on the output data:

i. *AREA*

ii. *VOLUME*

Part D:

Start date of the time series depending on the values of the BDT and EDT variables (starting and ending date and time of budget print-out)

Part E:

Time step used in the Simulation

Part F:

One of the following, depending on the output data (refer to the table above for further details):

i. *AG_AREA* (corresponds to column 2 in ASCII output file)

ii. *AG_POTNL_CUAW* (corresponds to column 3 in ASCII output file)

iii. *AG_SUP_REQ* (corresponds to column 4 in ASCII output file)

iv. *AG_PUMPING* (corresponds to column 5 in ASCII output file)

v. *AG_DIVER* (corresponds to column 6 in ASCII output file)

vi. *AG_SHORTAGE* (corresponds to column 7 in ASCII output file)

vii. *AG_RE-USE* (corresponds to column 8 in ASCII output file)

viii. *URB_AREA* (corresponds to column 9 in ASCII output file)

ix. *URB_SUP_REQ* (corresponds to column 10 in ASCII output file)

x. *URB_PUMPING* (corresponds to column 11 in ASCII output file)

xi. *URB_DIVER* (corresponds to column 12 in ASCII output file)

xii. *URB_SHORTAGE* (corresponds to column 13 in ASCII output file)

xiii. *URB_RE-USE* (corresponds to column 14 in ASCII output file)

xiv. *IMPORTS* (corresponds to column 15 in ASCII output file)

xv. *EXPORTS* (corresponds to column 16 in ASCII output file)

Stream Flow Budget **Unit 2**

Stream flow budgets are generated for all subregions specified to be printed in the main input file and the total modeled area. The title printed for each subregional stream flow budget includes IWFM version number, subregion name given by the user, the unit of data columns and the area of the subregion. The entire stream flow budget is in volumetric units. The output units (UNITVLOU) and conversion factor (FACTVLOU) for volume are specified by the user in the main budget input file.

The stream flow budget tables provide information on the flows in and out of the subregion as well as the impacts of other processes on stream flows within a subregion such as small stream watershed flows, tile drainage, surface runoff, return flows, diversions and bypass flows. Based on stream inflows to the subregion and other processes occurring within the subregion, the stream flow amount leaving the subregion is reported (*Downstream Outflow*). The *Diversion Shortage* column reports the difference between simulated diversions and the user specified diversion requirements. The following table defines each column in the stream flow budget table printed out to ASCII file and specifies the corresponding variable in the IWFM code:

STREAM FLOW BUDGET

COL. #	COLUMN NAME	VARIABLE	DESCRIPTION
1	Time	IFLAG	Time step
2	Upstream Inflow (+)	RUFLOW	Stream inflows to a subregion, which includes inflows from Unit 21 and flows from upstream reaches located in other subregions
3	Downstream Outflow (-)	RDFLOW	Stream flows leaving the subregion and either entering another subregion, or exiting the modeled area
4	Tributary Inflow (+)	RTRIB	Surface flows from small stream watersheds to the streams
5	Tile Drain (+)	RSTDRAIN	Inflows from tile drains
6	Runoff (+)	RROST	Direct runoff from rainfall into the streams
7	Return Flow (+)	RRTST	Return flow of the irrigation water into streams
8	Gain from Groundwater (+)	-RSTINF	Stream-groundwater interaction; a positive value denotes a gaining stream and a negative value indicates a losing stream
9	Gain from Lake (+)	RRLKIN	Inflow from upstream lakes
10	Diversion (-)	RDIVS	Diversions from the streams
11	Bypass Flow (-)	RBYPS	Net bypass flow within a subregion; for example, the bypass flow from one stream node to another within the subregion is the amount of water loss during the bypass process whereas bypass flow from a stream node in the subregion to a different subregion is the total amount bypassed from the stream node
12	Discrepancy (=)	RSERR	Error in the stream flow mass balance based on the preceding columns
13	Diversion Shortage	RDVSH	This column indicates whether the simulated stream flows are sufficient to meet the surface water diversion requirements; a value of zero indicates that stream flows are sufficient to meet the specified diversion requirements; a positive value represents the shortage of stream flow in a subregion

If a DSS file is used for print-out, the following pathnames are used:

Part A:

IWFM_STREAM_BUD

Part B:

SR*XXX (TTT)* where *XXX* is the subregion number and *TTT* is the name of the subregion

Part C:

VOLUME

Part D:

Start date of the time series depending on the values of the BDT and EDT variables (starting and ending date and time of budget print-out)

Part E:

Time step used in the Simulation

Part F:

One of the following, depending on the output data (refer to the table above for further details):

i. *UPSTRM_INFLOW* (corresponds to column 2 in ASCII output file)

ii. *DOWNSTRM_OUTFLOW* (corresponds to column 3 in ASCII output file)

iii. *TRIB_INFLOW* (corresponds to column 4 in ASCII output file)

iv. *TILE_DRN* (corresponds to column 5 in ASCII output file)

v. *RUNOFF* (corresponds to column 6 in ASCII output file)

vi. *RETURN_FLOW* (corresponds to column 7 in ASCII output file)

vii. *GAIN_FROM_GW* (corresponds to column 8 in ASCII output file)

viii. *GAIN_FROM_LAKE* (corresponds to column 9 in ASCII output file)

ix. *DIVERSION* (corresponds to column 10 in ASCII output file)

x. *BYPASS* (corresponds to column 11 in ASCII output file)

xi. *DISCREPANCY* (corresponds to column 12 in ASCII output file)

xii. *DIVER_SHORTAGE* (corresponds to column 13 in ASCII output file)

Root Zone Moisture Budget **Unit 3**

The root zone moisture budget is organized by subregion. A table is produced for each subregion specified for printing in the main input file, as well as the total modeled area. The title printed for each subregional root zone moisture budget includes IWFM version number, subregion name given by the user, the unit of data columns and the area of the subregion. The output units are specified by the user in the main budget input file.

The root zone moisture budget provides information on processes that are used to compute soil moisture in the root zone. Agricultural areas represent the areas where crops are located. Urban area includes indoor and outdoor urban areas and the native and riparian lands represent the undeveloped area in the subregion. For each area type (agricultural, municipal, and native and riparian vegetation), precipitation and irrigation (except for native and riparian vegetation areas) along with direct runoff and return flows are listed. The infiltration column is computed by adding the precipitation and prime irrigation water and subtracting the runoff and return flow. The following table describes the columns in the root zone moisture budget when printed out to an ASCII file:

ROOT ZONE MOISTURE BUDGET

COL. #	COLUMN NAME	VARIABLE	DESCRIPTION
1	Time	IFLAG	Time step
Agricultural Area			
2	Area	RLAND(IRAG)	Agricultural area
3	Precipitation	RRAIN(IRAG)*RLAND(IRAG)	Precipitation that falls on agricultural lands
4	Runoff	RROFF(IRAG)	Direct runoff of precipitation that falls on agricultural lands
5	Prime Applied Water	RDELI_AG+ RPUMP_AG	Amount of water applied for irrigation purposes excluding the re-used return flow; the time-series fraction of surface water diversions and pumping specified for irrigation purposes is located in Unit 27 of simulation
6	Reused Water	RUW_AG	The amount of re-used water on agricultural lands
7	Total Applied Water	RDELI_AG + RPUMP_AG + RUW_AG	Total irrigation water as a summation of prime applied water and the re-used water on agricultural lands
8	Return Flow	RRTRN(IRAG)	Net return flow of irrigation on agricultural lands (after re-use)
9	Beginning Storage	RSOILM_P(IRAG)	Root zone moisture in agricultural lands at the beginning of time step
10	Net Gain from Land Expansion (+)	RSOILMCH(IRAG)	The net moisture gained from other land use areas as the area of agricultural lands increase (a negative value represents loss of moisture due to the decrease of agricultural area)

11	Infiltration (+)	RINFILT(IRAG)	Total infiltration on the agricultural lands; computed as the summation of precipitation and applied water less runoff and return flow
12	Actual ET (–)	RETAC(IRAG)	Actual evapotranspiration in agricultural lands, which is computed based on ET rates under standard conditions in Unit 16 of simulation and root zone moisture values
13	Deep Percolation (–)	RPERC(IRAG)	Deep percolation from the root zone to the unsaturated zone in agricultural areas
14	Ending Storage (=)	RSOILM(IRAG)	Root zone moisture in agricultural lands at the end of the time step; computed as the summation of the beginning storage and infiltration less actual ET and deep percolation
Urban Area			
15	Area	RLAND(IRURB)	Urban area
16	Precipitation	RRAIN(IRURB)*RLAND(IRURB)	Precipitation that falls on urban lands
17	Runoff	RROFF(IRURB)	Direct runoff of precipitation that falls on urban lands
18	Prime Applied Water	RDELI_URB+ RPUMP_URB	Amount of water used for urban indoors and outdoors usage; this is the amount of water before the re-use of return flow is considered
19	Reused Water	RUW_URB	The amount of re-used water on urban lands
20	Total Applied Water	RDELI_URB + RPUMP_URB + RUW_URB	Total applied water as a summation of prime applied water and the re-used water on urban lands
21	Return Flow	RRTRN(IRURB)	Net return flow of applied water used for urban indoors and outdoors usage (after re-use)
22	Beginning Storage	RSOILM_P(IRURB)	Root zone moisture at the beginning of time step

23	Net Gain from Land Expansion (+)	RSOILMCH(IRURB)	The net moisture gained from other land use areas as the area of urban lands increase (a negative value represents loss of moisture due to the decrease of urban area)
24	Infiltration (+)	RINFILT(IRURB)	Total infiltration on the urban lands; computed as the summation of precipitation and applied water less runoff and return flow
25	Actual ET (–)	RETAC(IRURB)	Actual evapotranspiration in urban lands, which is computed based on ET rates under standard conditions in Unit 16 of simulation and root zone moisture values
26	Deep Percolation (–)	RPERC(IRURB)	Deep percolation from the root zone to the unsaturated zone in urban areas
27	Ending Storage (=)	RSOILM(IRURB)	Root zone moisture in urban lands at the end of the time step; computed as the summation of the beginning storage and infiltration less actual ET and deep percolation
Native & Riparian Vegetation			
28	Area	RLAND(IRNV)+RLAND(IRRV)	Native and riparian vegetation area
29	Precipitation	RRAIN(IRNV)*RLAND(IRNV)+ RRAIN(IRRV)*RLAND(IRRV)	Precipitation that falls on areas with natiave and riparian vegetation
30	Runoff	RROFF(IRNV)+RROFF(IRRV)	Direct runoff of precipitation that falls on areas with native and riparian vegetation
31	Beginning Storage	RSOILM_P(IRNV)+ RSOILM_P(IRRV)	Root zone moisture in areas with native and riparian vegetation at the beginning of time step
32	Net Gain from Land Expansion (+)	RSOILMCH(IRNV)+ RSOILMCH(IRRV)	The net moisture gained from other land use areas as the area of native and riparian vegetation increase (a negative value represents loss of moisture due to the decrease of native and riparian vegetation area)
33	Infiltration (+)	RINFILT(IRNV)+RINFILT(IRRV)	Total infiltration on areas with native and riparian vegetation; computed as precipitation less runoff

34	Actual ET (–)	RETAC(IRNV)+RETAC(IRRV)	Actual evapotranspiration in areas with native and riparian vegetation, which is computed based on ET rates under standard conditions in Unit 16 of simulation and root zone moisture values
35	Deep Percolation (–)	RPERC(IRNV)+RPERC(IRRV)	Deep percolation from the root zone to the unsaturated zone in areas with native and riparian vegetation
36	Ending Storage (=)	RSOILM(IRNV)+RSOILM(IRRV)	Root zone moisture in areas with native and riparian vegetation at the end of the time step; computed as the summation of the beginning storage and infiltration less actual ET and deep percolation

If a DSS file is used for print-out, the following pathnames are used:

Part A:

IWFM_ROOTZN_BUD

Part B:

SR*XXX (TTT)* where *XXX* is the subregion number and *TTT* is the name of the subregion

Part C:

One of the following, depending on the output data:

i. *AREA*

ii. *VOLUME*

Part D:

Start date of the time series depending on the values of the BDT and EDT variables (starting and ending date and time of budget print-out)

Part E:

Time step used in the Simulation

Part F:

One of the following, depending on the output data (refer to the table above for further details):

i. *AG_AREA* (corresponds to column 2 in ASCII output file)

ii. *AG_PRECIP* (corresponds to column 3 in ASCII output file)

iii. *AG_RUNOFF* (corresponds to column 4 in ASCII output file)

iv. *AG_PRM_H2O* (corresponds to column 5 in ASCII output file)

v. *AG_RE-USE* (corresponds to column 6 in ASCII output file)

vi. *AG_TOTAL_APP* (corresponds to column 7 in ASCII output file)

vii. *AG_RTRN_FLOW* (corresponds to column 8 in ASCII output file)

viii. *AG_BEGIN_STOR* (corresponds to column 9 in ASCII output file)

ix. *AG_GAIN_EXP* (corresponds to column 10 in ASCII output file)

x. *AG_INFILTR* (corresponds to column 11 in ASCII output file)

xi. *AG_ET* (corresponds to column 12 in ASCII output file)

xii. *AG_DEEP_PERC* (corresponds to column 13 in ASCII output file)

xiii. *AG_END_STOR* (corresponds to column 14 in ASCII output file)

xiv. *URB_AREA* (corresponds to column 15 in ASCII output file)

xv. *URB_PRECIP* (corresponds to column 16 in ASCII output file)

xvi. *URB_RUNOFF* (corresponds to column 17 in ASCII output file)

xvii. *URB_PRM_H2O* (corresponds to column 18 in ASCII output file)

xviii. *URB_RE-USE* (corresponds to column 19 in ASCII output file)

xix. *URB_TOTAL_APP* (corresponds to column 20 in ASCII output file)

xx. *URB_RTRN_FLOW* (corresponds to column 21 in ASCII output file)

xxi. *URB_BEGIN_STOR* (corresponds to column 22 in ASCII output file)

xxii. *URB_GAIN_EXP* (corresponds to column 23 in ASCII output file)

xxiii. *URB_INFILTR* (corresponds to column 24 in ASCII output file)

xxiv. *URB_ET* (corresponds to column 25 in ASCII output file)

xxv. *URB_DEEP_PERC* (corresponds to column 26 in ASCII output file)

xxvi. *URB_END_STOR* (corresponds to column 27 in ASCII output file)

xxvii. *NRV_AREA* (corresponds to column 28 in ASCII output file)

xxviii. *NRV_PRECIP* (corresponds to column 29 in ASCII output file)

xxix. *NRV_RUNOFF* (corresponds to column 30 in ASCII output file)

xxx. *NRV_BEGIN_STOR* (corresponds to column 31 in ASCII output file)

xxxi. *NRV_GAIN_EXP* (corresponds to column 32 in ASCII output file)

xxxii. *NRV_INFILTR* (corresponds to column 33 in ASCII output file)

xxxiii. *NRV_ET* (corresponds to column 34 in ASCII output file)

xxxiv. *NRV_DEEP_PERC* (corresponds to column 35 in ASCII output file)

xxxv. *NRV_END_STOR* (corresponds to column 36 in ASCII output file)

Groundwater Budget Unit 4

A groundwater budget table is produced for each subregion specified for printing in the main input file, as well as the total modeled area. The title printed for each subregional groundwater budget includes IWFM version number, subregion name given by the user, the unit of data columns and the area of the subregion. The output units and the conversion factors are specified by the user in the main budget input file.

The groundwater budget reports the inflows and outflows as well as the beginning and ending groundwater storages. The deep percolation of water from the root zone to the unsaturated zone to compare to the net deep percolation into the groundwater and the cumulative subsidence are also reported. The following list describes the columns in the groundwater budget table as printed to an ASCII file:

GROUNDWATER BUDGET

COL. #	COLUMN NAME	VARIABLE	DESCRIPTION
1	Time	IFLAG	Time step
2	Deep Percolation	RPERCE	Total deep percolation from the root zone to the unsaturated zone in a subregion; this column is included to compare deep percolation to net deep percolation and is not included in the groundwater mass balance
3	Beginning Storage (+)	RGWSTP	Groundwater storage at the beginning of the time step
4	Ending Storage (–)	RGWSTO	Groundwater storage at the end of time step
5	Net Deep Percolation (+)	RNETP	Recharge to the groundwater; this column represents the outflow from the unsaturated layer directly above the aquifer
6	Gain from Stream (+)	RSTINF	Amount of stream flow that contributes to groundwater; stream-groundwater interaction due to a losing stream is defined as a positive value whereas a gaining stream is defined as a negative value
7	Recharge (+)	RRECH	Recharge to the aquifer from injection wells and recoverable loss of diversions and bypasses
8	Gain from Lake (+)	RLAKE	Lake-groundwater interaction; a positive value represents flow from lake into groundwater, a negative value represents flow from groundwater into lake
9	Boundary Inflow (+)	RBOUND	Net inflow into groundwater due to boundary conditions
10	Subsidence (+)	RGWSTOC–RGWSTPC	Amount of flow released out of groundwater storage due to subsidence
11	Subsurface Irrigation (+)	RSUBIRIG	Contribution of subsurface irrigation to groundwater storage
12	Tile Drain Outflow (–)	RGWDRAIN	Groundwater that flows into tile drains

13	Pumping (–)	RPUMP	Total subregional groundwater pumping
14	Net Subsurface Inflow (+)	RSUBFL	Net groundwater inflow into the subregion from the surrounding subregions
15	Discrepancy (=)	RGWERR	Error in the groundwater mass balance based on the preceeding columns
16	Cumulative Subsidence	RGWSTOC	Cumulative volume of groundwater storage lost due to land subsidence

If a DSS file is used for print-out, the following pathnames are used:

Part A:

IWFM_GW_BUD

Part B:

SR*XXX (TTT)* where *XXX* is the subregion number and *TTT* is the name of the subregion

Part C:

VOLUME

Part D:

Start date of the time series depending on the values of the BDT and EDT variables (starting and ending date and time of budget print-out)

Part E:

Time step used in the Simulation

Part F:

One of the following, depending on the output data (refer to the table above for further details):

i. *DEEP_PERC* (corresponds to column 2 in ASCII output file)

ii. *BEGIN_STORAGE* (corresponds to column 3 in ASCII output file)

iii. *END STORAGE* (corresponds to column 4 in ASCII output file)

iv. *NET_DEEP_PERC* (corresponds to column 5 in ASCII output file)

v. *GAIN_FROM_STRM* (corresponds to column 6 in ASCII output file)

vi. *RECHARGE* (corresponds to column 7 in ASCII output file)

vii. *GAIN_FROM_LAKE* (corresponds to column 8 in ASCII output file)

viii. *BOUNDARY_INFLOW* (corresponds to column 9 in ASCII output file)

ix. *SUBSIDENCE* (corresponds to column 10 in ASCII output file)

x. *SUBSURF_IRRIGATION* (corresponds to column 11 in ASCII output file)

xi. *TILE_DRAINS* (corresponds to column 12 in ASCII output file)

xii. *PUMPING* (corresponds to column 13 in ASCII output file)

xiii. *NET_SUBSURF_INFLOW* (corresponds to column 14 in ASCII output file)

xiv. *DISCREPANCY* (corresponds to column 15 in ASCII output file)

xv. *CUM_SUBSIDENCE* (corresponds to column 16 in ASCII output file)

An element sub-group report is given for each element sub-group specified in the element characteristics pre-processor input file (Unit 13). The report is useful for displaying output for areas that do not encompass a specified subregion. The title of each report includes the IWFM version number, the sub-group number and the unit of output values. The following list defines the columns in this output file as printed to an ASCII file:

ELEMENT SUB-GROUP DETAILS

COL. #	COLUMN NAME	VARIABLE	DESCRIPTION
1	Time	IFLAG	Time step
Lands within the Sub-group			
2	Agricultural Supply Requirement	SDMAG	Sub-group agricultural demand
3	Urban Supply Requirement	SDMUR	Sub-group urban demand
4	Return Flow	SRTRN	Return flows from water applied to agricultural and urban lands
5	Deep Percolation	SPERC	Deep percolation of water from the root zone to the unsaturated zone within the sub-group area
6	Runoff	SROFF	Direct runoff of precipitation within the sub-group
Streams within the Sub-group			
7	Return Flow to Streams	SRTST	Return flow into the streams within the sub-group
8	Runoff to Streams	SROST	Direct runoff that flows into streams within the sub-group
9	Gain from Groundwater	-SSTINF	Stream-groundwater interaction within the sub-group; a positive value indicates a gaining stream whereas a losing stream is represented as a negative value
10	Diversion	SRDV	Water diverted from streams within a sub-group

11	Diversion Shortage	SRDVSH	Amount of water unable to fulfill surface water diversion requirements due to insufficient stream flows
Groundwater within Sub-group			
12	Pumping	SPUMP	Total groundwater pumping within a sub-group
13	Ending Storage	SGWST	Volume of groundwater within a sub-group at the end of the time step
14	Cumulative Subsidence	SGWSTC	Cumulative volume of groundwater storage lost due to land subsidence

If a DSS file is used for print-out, the following pathnames are used:

Part A:

IWFM_SUBGRP_BUD

Part B:

SG*XXX* where *XXX* is the subgroup number

Part C:

VOLUME

Part D:

Start date of the time series depending on the values of the BDT and EDT variables (starting and ending date and time of budget print-out)

Part E:

Time step used in the Simulation

Part F:

One of the following, depending on the output data (refer to the table above for further details):

i. *AG_SUPP_REQ* (corresponds to column 2 in ASCII output file)

ii. *URB_SUPP_REQ* (corresponds to column 3 in ASCII output file)

iii. *RTRN_FLOW* (corresponds to column 4 in ASCII output file)

iv. *DEEP_PERC* (corresponds to column 5 in ASCII output file)

v. *RUNOFF* (corresponds to column 6 in ASCII output file)

vi. *RTRN_FLOW_STRM* (corresponds to column 7 in ASCII output file)

vii. *RUNOFF_STRM* (corresponds to column 8 in ASCII output file)

viii. *GAIN_FROM_GW* (corresponds to column 9 in ASCII output file)

ix. *DIVERSION* (corresponds to column 10 in ASCII output file)

x. *DIVER_SHORTAGE* (corresponds to column 11 in ASCII output file)

xi. *PUMPING* (corresponds to column 12 in ASCII output file)

xii. *END_STORAGE* (corresponds to column 13 in ASCII output file)

xiii. *CUM_SUBSIDENCE* (corresponds to column 14 in ASCII output file)

Small Watershed Flow Components Unit 6

Small stream watersheds surrounding the study domain are modeled as boundary conditions and contribute surface water and groundwater flows to the system. The small stream watershed flow components report provides tables for each small stream watershed modeled. The title for each small watershed includes IWFM version number, small stream watershed identification number and the unit of output values. The following list defines the columns in the report as printed to an ASCII file:

SMALL WATERSHED FLOW COMPONENTS

COL. #	COLUMN NAME	VARIABLE	DESCRIPTION
1	Time	IFLAG	Time step
2	Total SW Outflow	SWSUR	Total amount of surface flow from the small stream watershed boundary to the modeled area
3	GW Base Outflow	SWSUB	Total amount of groundwater flow from the small watershed into the modeled area
4	Base Flow + Surface Percolation	SWINF	The sum of the groundwater base outflow from the small watershed boundary and surface flow that percolates to the groundwater while en-route to a stream within the modeled area from the small stream watershed
5	Net Surface Outflow to Streams	SWOFF	Total surface water outflow less the surface percolation

If a DSS file is used for print-out, the following pathnames are used:

Part A:

IWFM_SWSHED_BUD

Part B:

SW*XXX* where *XXX* is the small watershed number

Part C:

VOLUME

Part D:

Start date of the time series depending on the values of the BDT and EDT variables (starting and ending date and time of budget print-out)

Part E:

Time step used in the Simulation

Part F:

One of the following, depending on the output data (refer to the table above for further details):

i. *TOTAL_SW_OUTFLOW* (corresponds to column 2 in ASCII output file)

ii. *GW_BASE_OUTFLOW* (corresponds to column 3 in ASCII output file)

iii. *BASEFLOW+PERCOLATION* (corresponds to column 4 in ASCII output file)

iv. *SURFACE_FLOW_TO_STRM* (corresponds to column 5 in ASCII output file)

Lake Budget Unit 7

Lakes are modeled to determine their interaction with the groundwater and the stream system. The lake budget provides the lake water balance, lake storage and lake surface elevation at the end of each time interval. The title lines for each lake budget include IWFM version number, lake identification number and the unit of output data.

The following list defines the columns in the lake budget as printed to an ASCII file:

LAKE BUDGET

COL. #	COLUMN NAME	VARIABLE	DESCRIPTION
1	Time	IFLAG	Time step
2	Beginning Storage (+)	STLAKE_P	Lake storage at the beginning of the time step
3	Ending Storage (–)	STLAKE	Lake storage computed at the end of the time step
4	Flow from Upstream Lake (+)	QUPLKIN	Inflow from lake(s) that are located upstream of the lake
5	Flow from Bypasses (+)	QLKFL	Inflow into the lake from bypasses
6	Precipitation (+)	QLPRCP	Amount of precipitation that falls on the lake surface, which is based on precipitation and the rainfall station(s) associated with lake elements
7	Gain from Groundwater (+)	-RLKINF	Lake-groundwater interaction; a positive value indicates that the flow from the groundwater into the lake, whereas a negative value indicates flow from the lake to the groundwater system
8	Lake Evaporation (–)	QLKEV	Evaporation from the lake surface
9	Lake Outflow (–)	QLKOUT	Spill from lake as the lake surface elevation raises above the maximum lake elevation
10	Discrepancy (=)	RLKERR	Mass balance error for lake
11	Lake Surface Elevation	HLAKE	Lake elevation that corresponds to the simulated lake storage

If a DSS file is used for print-out, the following pathnames are used:

Part A:

IWFM_LAKE_BUD

Part B:

LK*XXX* where *XXX* is the lake number

Part C:

One of the following, depending on the output:

i. *ELEV*

ii. *VOLUME*

Part D:

Start date of the time series depending on the values of the BDT and EDT variables (starting and ending date and time of budget print-out)

Part E:

Time step used in the Simulation

Part F:

One of the following, depending on the output data (refer to the table above for further details):

i. *BEGIN_STORAGE* (corresponds to column 2 in ASCII output file)

ii. *END_STORAGE* (corresponds to column 3 in ASCII output file)

iii. *FLOW_FROM_UP_LAKE* (corresponds to column 4 in ASCII output file)

iv. *FLOW_FROM_BYPASS* (corresponds to column 5 in ASCII output file)

v. *PRECIP* (corresponds to column 6 in ASCII output file)

vi. *GAIN_FROM_GW* (corresponds to column 7 in ASCII output file)

vii. *EVAPOTR* (corresponds to column 8 in ASCII output file)

viii. *OUTFLOW* (corresponds to column 9 in ASCII output file)

ix. *DISCREPANCY* (corresponds to column 10 in ASCII output file)

x. *SURFACE_ELEV* (corresponds to column 11 in ASCII output file)

Stream Reach Budget Unit 8

The stream reach budget includes a table for each stream reach modeled that displays the mass balance in a stream reach. The title for each stream reach budget table includes the IWFM version number, stream reach identification number and volumetric units for the values in each column. The stream reach flow components printed to the ASCII file are listed as follows:

STREAM REACH BUDGET

COL. #	COLUMN NAME	VARIABLE	DESCRIPTION
1	Time	IFLAG	Time step
2	Upstream Inflow (+)	RHUFLOW	Inflow at the first upstream node of the reach

3	Downstream Outflow (–)	RHDFLOW	Stream flow leaving the reach and entering another reach
4	Tributary Inflow (+)	RHTRIB	Surface flows from small stream watersheds into the stream reach
5	Tile Drain (+)	RHDRAIN	Tile drain flows into the reach
6	Runoff (+)	RHROST	Direct runoff due to precipitation into the stream reach
7	Return Flow (+)	RHRTST	Return flow of agricultural and urban applied water to a stream reach
8	Gain from Groundwater (+)	-RHSTINF	Amount of water contributed to the reach from groundwater; a positive value represents a net flow from groundwater to the reach, a negative value represents a net flow from reach to the groundwater
9	Gain from Lake (+)	RHRLKIN	Contribution of outflow from upstream lake(s) to the reach
10	Diversion (–)	RHDIVS	Amount of water diverted from the stream reach
11	Bypass Flow (–)	RHBYPS	Net amount of water that is diverted as bypass flow from the stream reach
12	Discrepancy (=)	RHSERR	Error in the reach flow mass balance based on the preceding columns
13	Diversion Shortage	RHDVSH	This column indicates whether the simulated reach flows are sufficient to meet the surface water diversion requirements; a value of zero indicates that reach flows are sufficient to meet the specified diversion requirements; a positive value represents the shortage of flow in a reach

If a DSS file is used for print-out, the following pathnames are used:

Part A:

IWFM_STRMRCH_BUD

Part B:

RR*XXX* where *XXX* is the stream reach number

Part C:

VOLUME

Part D:

Start date of the time series depending on the values of the BDT and EDT variables (starting and ending date and time of budget print-out)

Part E:

Time step used in the Simulation

Part F:

One of the following, depending on the output data (refer to the table above for further details):

i. *UPSTRM_INFLOW* (corresponds to column 2 in ASCII output file)

ii. *DOWNSTRM_OUTFLOW* (corresponds to column 3 in ASCII output file)

iii. *TRIB_INFLOW* (corresponds to column 4 in ASCII output file)

iv. *TILE_DRN* (corresponds to column 5 in ASCII output file)

v. *RUNOFF* (corresponds to column 6 in ASCII output file)

vi. *RETURN_FLOW* (corresponds to column 7 in ASCII output file)

vii. *GAIN_FROM_GW* (corresponds to column 8 in ASCII output file)

viii. *GAIN_FROM_LAKE* (corresponds to column 9 in ASCII output file)

ix. *DIVERSION* (corresponds to column 10 in ASCII output file)

x. *BYPASS* (corresponds to column 11 in ASCII output file)

xi. *DISCREPANCY* (corresponds to column 12 in ASCII output file)

xii. *DIVER_SHORTAGE* (corresponds to column 13 in ASCII output file)

Diversion Detail Report **Unit 9**

This data file reports surface water deliveries and diversions, as well as the difference between the specified and actual deliveries and diversions for each subregion for all time intervals within the specified beginning and ending time step. The diversion detail report for the entire model area is not produced. Each report title indicates IWFM version, the area of subregion and the volumetric units associated with the table values.

The row labeled *Diversion #* consists of the diversion identification numbers in the subregion. Diversion identification numbers are specified in the simulation file Unit 25 by the user. A delivery is specified as (+) and a diversion as (–). The row labeled *Stream Node* lists the stream nodes where the diversions originate. A value of zero indicates a stream node outside the model boundary. A delivery is exported out of the model boundary when the stream node associated with the delivery is defined as zero. A diversion is imported from outside the model boundary when a zero value is specified for the corresponding stream node. The values in the table (not in parentheses) are the actual deliveries and diversions at each time interval. The value in parentheses represents the reduction with respect to the diversion and delivery requirements specified in simulation file Unit 26.

If a DSS file is used for print-out, the following pathnames are used:

Part A:

IWFM_DIVERDTL_BUD

Part B:

SR*XXX*:DV*YYY*:R*ZZZ* where *XXX* is the subregion number, *YYY* is the diversion ID number as listed in the diversion specifications file in the Simulation part, and *ZZZ* is the stream node where the diversion originates (*ZZZ* is set to 0 for diversions that originate from outside the model area)

Part C:

VOLUME

Part D:

Start date of the time series depending on the values of the BDT and EDT variables (starting and ending date and time of budget print-out)

Part E:

Time step used in the Simulation

Part F:

One of the following, depending on the output data:

i. *DELI* (actual delivery into subregion *XXX*, from diversion ID *YYY* that originates from stream node *ZZZ*)

ii. *DELI_SHORT* (shortage of delivery calculated as the required delivery less actual delivery)

iii. *DIVER* (actual diversion from subregion *XXX*, through diversion ID *YYY* that originates from stream node *ZZZ*)

iv. *DIVER_SHORT* (diversion shortage calculated as the required diversion less the actual diversion)

6. Running IWFM

Running IWFM is a three step procedure the first time the model is run for a specific application. The pre-processing program is executed to set geometric, hydrologic and stratigraphic characteristics of the model domain. The pre-processing information is used, in conjunction with boundary conditions, initial conditions, and hydrologic data to run the simulation model. The binary output generated from IWFM simulation is then processed into tabular form using the Budget and Z-Budget executable programs. It is not necessary to execute the pre-processor for subsequent runs of a specific study area, given the characteristics of the domain are the same. Simply use the binary file generated in the previous Pre-processor run as input to the new simulation run.

To run IWFM, install a copy of the Pre-processor, Simulation, Budget and Z-Budget executable programs, as well as the input files necessary to run each portion of the program for a specific application. Figure 6.1 is a suggested way to organize your files within a folder structure.

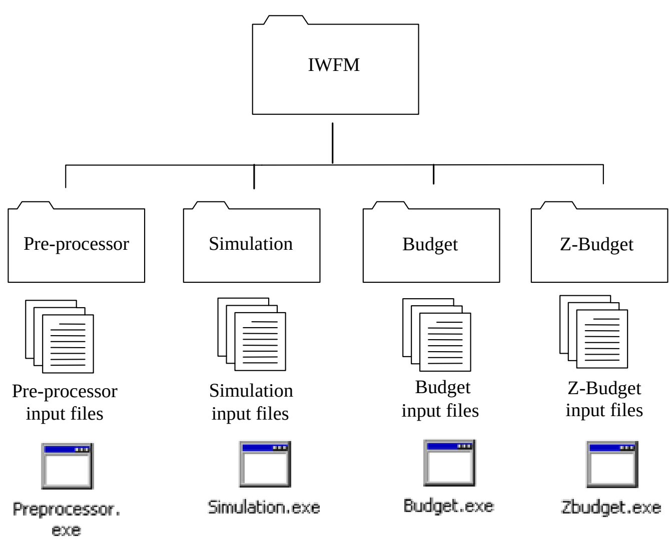
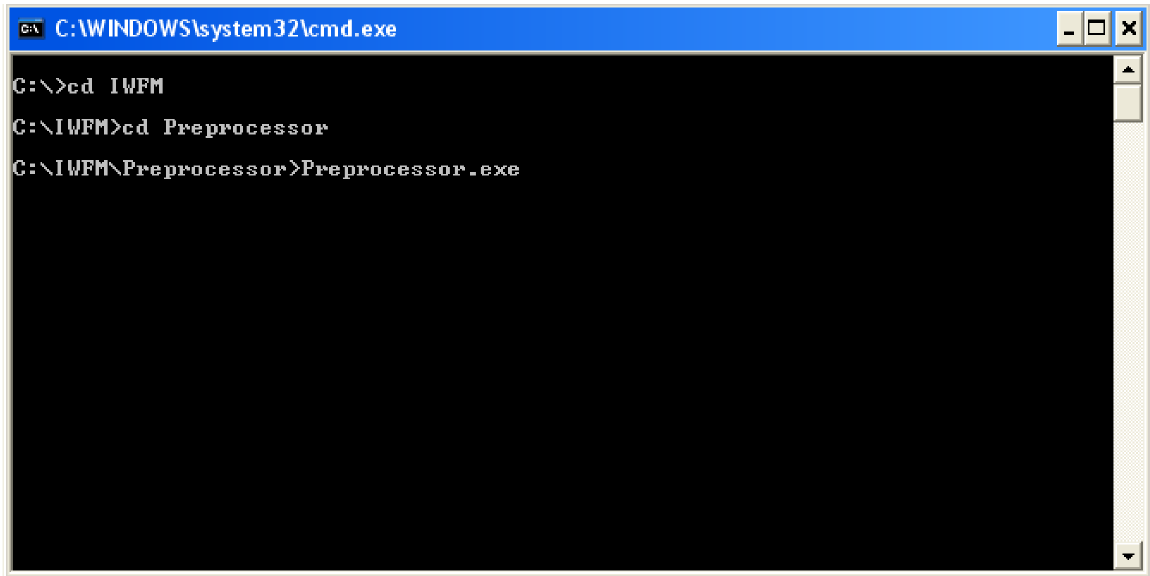
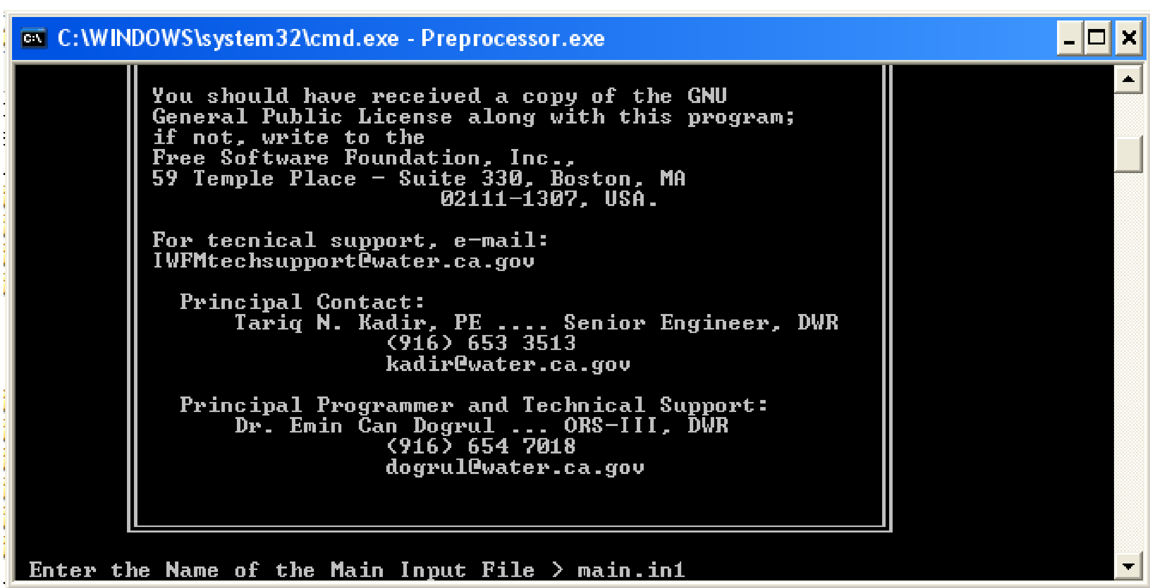


Figure 6.1 Suggested organization of IWFM folder structure

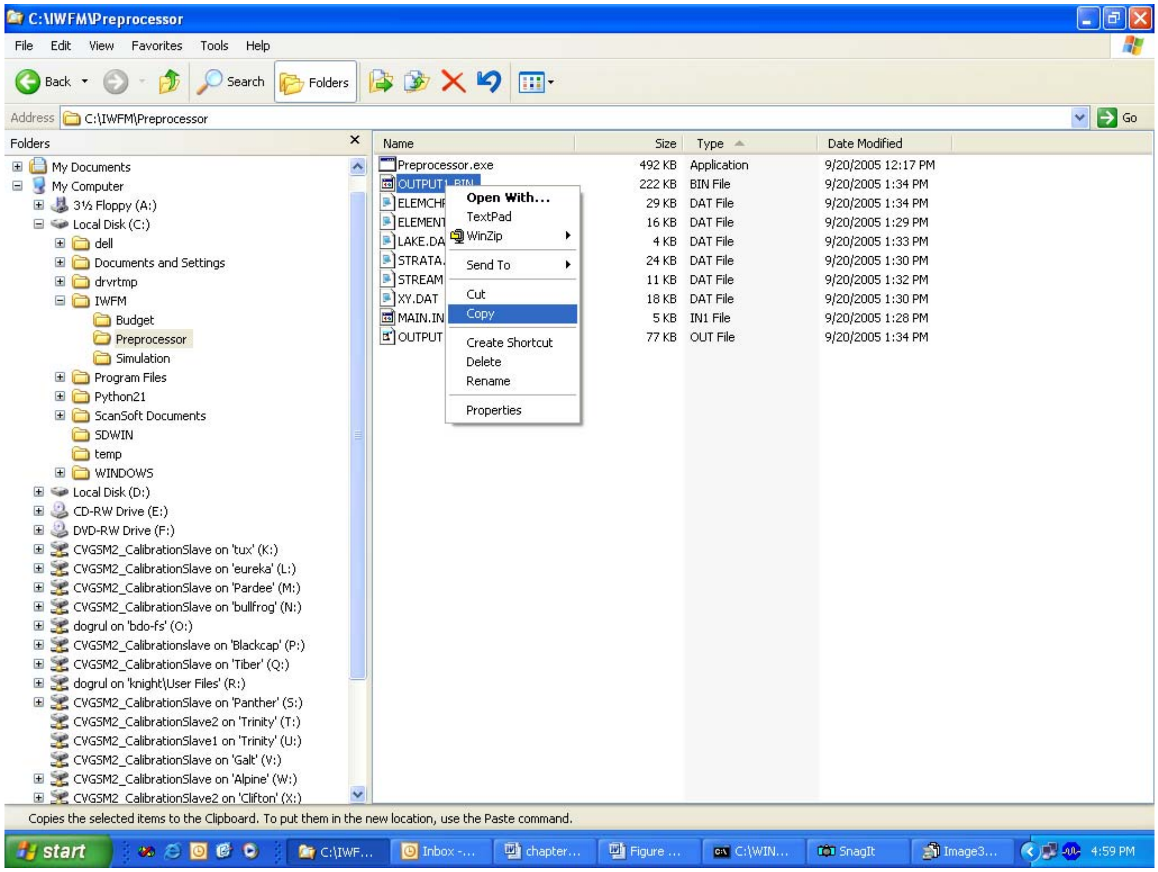
The folder structure illustrated in Figure 6.1 is used in the explanation of how to run IWFM. Once the folder structure is organized, open an MS-DOS prompt window, navigate to the directory that contains the IWFM Pre-processor executable, and enter the executable name.



The Pre-processor will then prompt the user to enter the main input control file.

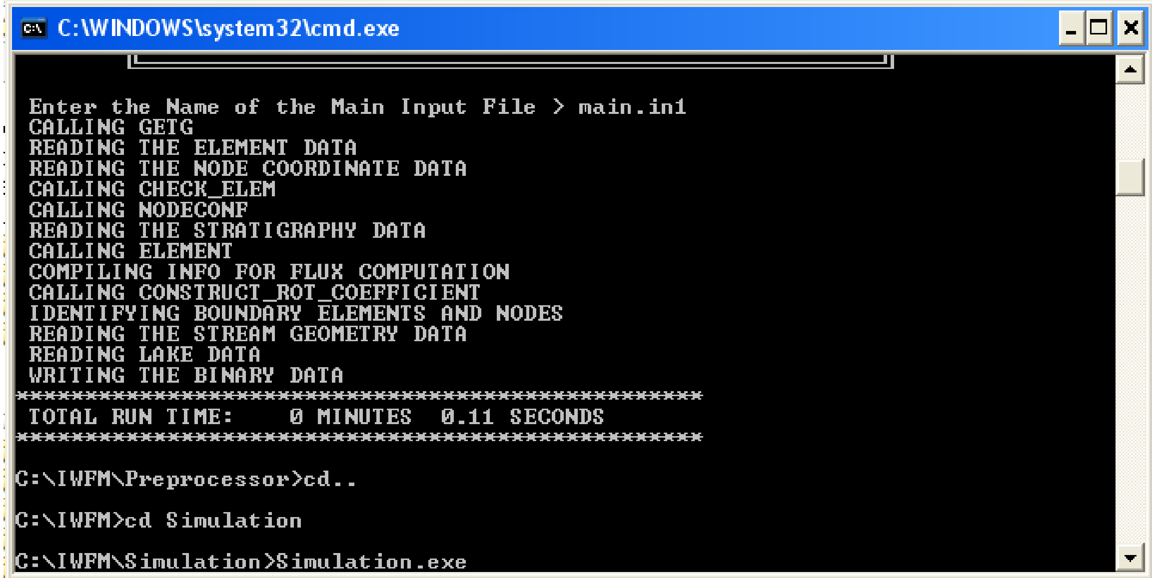


Upon completion of running the Pre-processor, the user must copy the binary output generated to the Simulation folder.

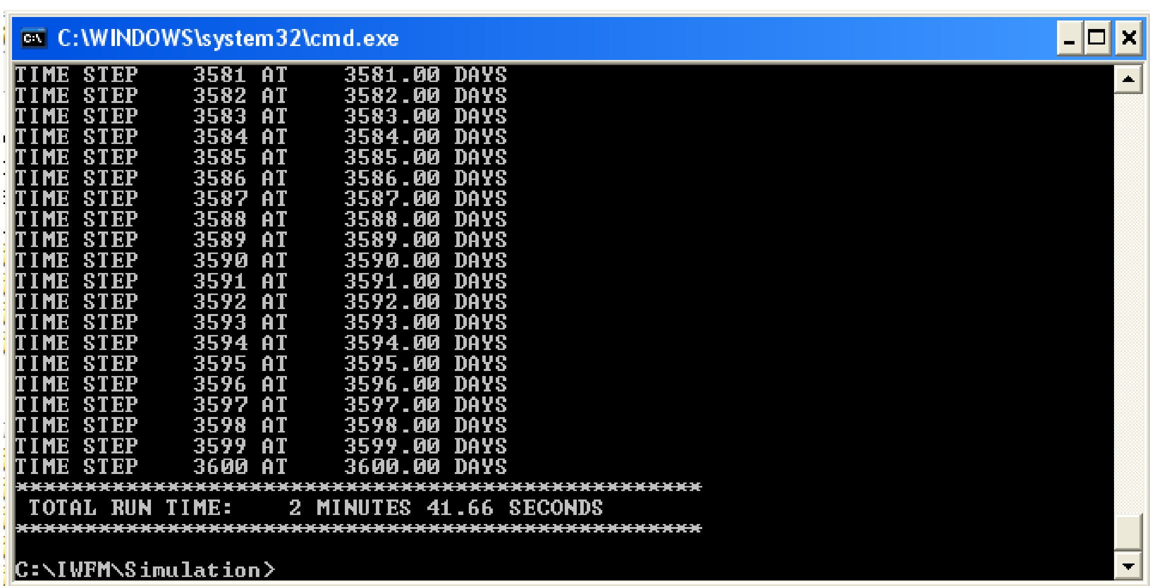


Given that the Simulation folder already includes the executable program and necessary input files, pasting a copy of the binary output file generated from the Pre-processor is the last step before running the simulation portion of IWFM.

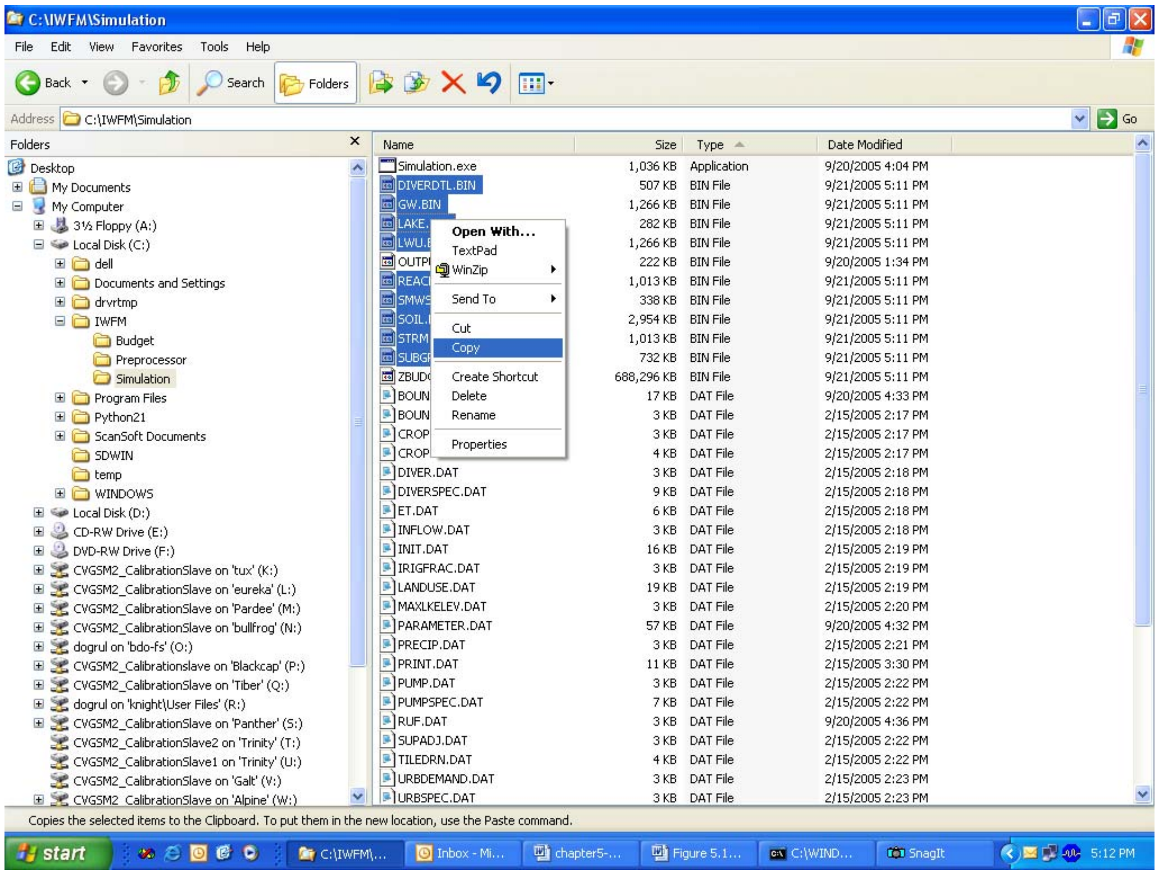
Within the MS-DOS prompt window, navigate to the Simulation folder, and enter the Simulation executable name.



The program then prompts the user to specify the main input file for Simulation. Once Simulation is completed, the program will specify the total run time required for the simulation. Note that the total run time will be printed correctly only when running IWFM on Windows NT, Windows 2000 and Windows XP operating systems.



The next step is to process the information generated from Simulation into tables. Copy relevant binary files generated in the Simulation and paste them into the Budget and Z-Budget folders, as shown below.



Running the Budget and Z-Budget is done in the same manner as running the first two portions of the IWFM. The user must navigate to the relevant folder (that contains the files necessary to run the executable), execute the program, and provide the main input file name. The Budget and Z-Budget executable programs organize and tabulate the Simulation output.

Compilation of IWFM requires all source code and a Fortran compiler. The California Department of Water Resources (DWR) has used Intel Visual Fortran Version XE-12.0.2 for the development and testing of this version of IWFM and supplies technical support on this version. However, DWR does not provide technical support for versions of IWFM modified by other users.